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The MONTHLY REVIEW

Published by the AMERICAN ELECTRO-PLATERS' SOCIETY

A Society
for the Advancement of the Science of
Electro-Plating

APRIL 1936 · IN THIS ISSUE

Editorial — We Are Going Forward 3
Slattery — The A. E. S. Should Have a Full Time Salaried Man 5
Convention Notes 7
Transportation Arrangements for the Convention 9
List of Exhibits to Date 10
Committee on the Selection of Prize Awards for Papers 11
Proposed Amendments to the Constitution of the A. E. S. 12
W. Blum and A. Brenner — The Application of Meale's Chord Method in the Measurement of the Thickness of Electrodeposits 14
Johnson — Reading on Plating Racks 21
Crampton — Improvements in the Brass Industry 23
Hay — Important Facts Governing Cyanide Plating 31
Blum — Observations on Electroplating in Europe 38
Tingley — How Do We Learn 47
The Abstract Section 54
Branch News 60
Membership Report 72
Buyer's Guide 74
Branch Directory 75

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The Monthly Review

Published by the
AMERICAN ELECTRO-PLATERS' SOCIETY

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We Are Going Forward!

In reflecting upon the changes in our organization within the past decade, we have been thinking of the general attitude of the delegates attending our annual conventions. Years ago many men sent to the convention to gain something useful, whiled away their time in "social affairs" and could not give a detailed report of what transpired at the meetings.

But, today we find such a different atmosphere. Outside entertainment is not offered so freely. Many delegates attend the sessions, with pencil and note-book handy, and when they return to their places of business have a definite comprehensive account of the various sessions. With these notes so handy, they can make use of them in attacking the various problems connected with the position they hold.

Not only is there a decided change in the attitude of the delegates, but of the entire membership which is working for a more progressive organization. Many of our foremen platers are taking their rightful places on the speakers' platform—reading papers, discussing the technical and practical sides of our industry in company with college professors and chemists. This is a truly healthful sign of our growth. Let's have more papers from the foremen!

It is a point of satisfaction and pride to us that we are being recognized by leading technical societies and leaders the world over. At the last convention in Bridgeport, there were at least nine doctors including our own Dr. Blum, who presented papers, thanks to Mr. George Hogaboom and his educational committee.

One of the important gains during the past year under President Slattery and Mr. J. Underwood has been the increased mem-

bership as a result of our intensive drive. But—we should not stop until we have every foreman and his assistant enrolled. And some day we hope to let down all barriers regarding members and allow all who are interested in the art of electro-plating into our ranks.

With these advances just reviewed, we are ready to go forward. On another page of the REVIEW, one of our Branches presents a resolution that is a forward advance of great importance. It is that a man from within our ranks be appointed as Executive Secretary. His duties will be to "sell" the A. E. S. so that branches may be strengthened, advertising increased, research in every detail broadened, and the aims and objects of our entire organization so presented to the industrial world that no one will have any misconception of the value and work of our society.

Many times we receive requests for a "bigger and better" REVIEW. This, naturally, means increased cost which can only be supplied by increased advertising revenue. Writing letters to prospective advertisers isn't sufficient. We must have the personal contact with these people to prove that advertising in the REVIEW pays.

The writer has no hesitation in saying that our business sessions could be conducted more efficiently. We waste too much time discussing unimportant things, when more time could be given to essential items that are of value to all. We also dare to suggest that the final business session should not be the last item on the program. This is a most important part of our convention program, and too many delegates are on their way home by the time the meeting is called.

As we meet in Cleveland, we have larger opportunities to greet us than ever greeted any convention. The resolution just mentioned must be carefully considered at Branch meetings and delegates instructed. We cannot afford to be afraid of it just because it is new. It must come eventually—why not now? The organization is no longer a baby, but is now grown up and natural growth necessarily brings great changes.

Our Society has been victor over the depression; we are now "on our way". How far we go is up to us. Other societies have been successful with the plan outlined above. If we hesitate, it will stunt our growth.

The A. E. S. Should have a Full Time Salaried Man

Our present Editor, Mr. W. J. R. Kennedy, has advanced the idea in editorials appearing in the MONTHLY REVIEW, and in reports to the Annual Conventions, that our Society should have a full time salaried man to create new branches, to stimulate the weak and discouraged groups, and to inform the leaders of industrial plants of our educational and research activities. I take the liberty to quote him from a few of his writings:

"Report of the Editor to the Twenty-Second Annual Convention, 1933-1934:

"Let us find a man to fill the office of Research Director, even if we have to create an office and pay a salary to such a man."

"Report of the Editor to the Twenty-Third Annual Convention, 1934-1935:

"If the Society would create an office appointing a man of Mr. Hogaboom's type to devote his time to the creating of new Branches, stimulating branches that are weak and discouraged, laying the claims of our organization with its research and educational qualities before the leaders of our industrial plants, and others interested in the electrodeposition of metals, the benefits would be hundred-fold in increased membership, finances and good will. We believe, moreover, that the salary of such a man would be forthcoming without any great strain on the treasury because of the type of work in which he would be engaged. This idea is practical, and should be considered in the near future. All of our members now in office have to depend on the job they hold in some factory for their daily bread. This limits them to the routine work of the President, Secretary or Editor's office, which can only be done in their spare time. It is out of the question to expect any, or all of them, to do more than is now being done, which means that we are leaving a very important part of the Society's work undone."

During February, upon the request of the Cleveland Branch Convention Committee, I prepared a copy for their program, and in mentioning the MONTHLY REVIEW in this article I wrote as

follows: "The scope and quality of our MONTHLY REVIEW has greatly improved in the past years, not only because more and better papers have been presented to the branches and our conventions, but also because the income for advertising has permitted their publication. The Abstract Section has helped progressive platers to keep in touch with the developments in every field of electrodeposition. For this we are indebted partly to *Chemical Abstracts* and *Metals and Alloys*, both of which permit us to reprint their abstracts with special reference to persons who have prepared original abstracts with special reference to the needs of electroplaters. The improvement that has been made with the REVIEW illustrates the possibilities for larger accomplishments, which in my opinion, warrants serious consideration to the employment of a full time Editor, or Executive Secretary."

After serving as an officer and member of the Executive Board for three years, and your President the past year, I am fully convinced that the proposed amendments to the Constitution by the Baltimore-Washington Branch are worthy of the approval and support of every branch member and delegate to our Twenty-Fourth Annual Meeting.

The work of the Editor's office, and the Secretary-Treasurer's duties, have increased tremendously. The present Editor could not possibly attend to the editing, printing, mailing and billing the MONTHLY REVIEW, if it were not for the assistance he receives from the members of his family, namely, his wife and three daughters.

Our present Secretary-Treasurer, in order to keep up the correspondence of his office up to date, has found it necessary to resort to the services of two young ladies in the office of his organization to take dictation and get out the overflow of letters which he personally would be unable to take care of.

The appointment of a paid full time Executive Secretary for our Society is a good business venture, and should pay handsome returns. Let every member read this copy, study the amendments carefully, and if you are progressive electroplaters and executives, I believe you will realize the wisdom of the adoption of the amendments proposed by the Baltimore-Washington Branch.

T. F. SLATTERY,
President.

Convention Notes

While our Educational Program Committee, under the leadership of Mr. J. S. Nachtman, has been assembling the results of their campaign for papers and speakers, your scribe has endeavored to delineate in a small way the possibilities of a week in Cleveland.

We hope that we have been able to sell you the idea that you cannot afford to stay away from the Cleveland Convention. In case any of our friends and members are still in doubt as to their plans we feel that the following list of outstanding investigators and plating authorities will convince you that you will miss the opportunity of the year if you fail to appear Monday morning June 1st at the opening Educational session.

The definite schedule for the Educational Sessions has not as yet been drawn up but on some session's program you will find listed the following names:

Dr. Blum, U. S. Bureau of Standards, Washington, D. C.
Dr. Casper, U. S. Bureau of Standards, Washington, D. C.
Mr.P.W.Strausser,U.S.Bureau of Standards,Washington,D.C.
(A. E. S. Research Associate)
Mr. M.R.Thompson,Bureau of Standards, Washington, D. C.
Mr. W. M. Phillips, Research Chairman, Geberal Motors, Detroit, Mich.
Mr. George Hogaboom, Hanson-Van Winkle-munning
Chas. L. Faust, Battelle Memorial Institute
Leslie Holt, University of Wisconsin
Dr. Mattes, University of Indiana
Dr. Soderberg, The Udylite Company
Walter H. Meyer, General Electric Co.
A. G. Spencer, Chevrolet Motor Co.
Dr. Waite, McGean Chemical Co.
Dr. Mantell, Pratt Institute, Brooklyn
J. N. Cosgrove, Noblitt-Sparks Industries
Dr. Baker, University of Michigan
Dr. Carl Johnson, Oakite Products, New York City
H. R. Power, Chemical Engineer, The Carborundum Co.
Lionel Cinamon, New York Branch
Harry P. Coats, Firestone Steel Products
Mr. Farber, Westinghouse Electric Co., Mansfield, O.
E. A. Anderson, New Jersey Zinc Co.
Mr. Donald Wood, Pres. Boston Branch, Taunton, Mass.
Dr. Work, Aluminum Company of America

It is too early to divulge the topic to be discussed by the various speakers, but from our past experience we will leave each session wiser from their counsel and above all, which is of the utmost benefit to us individually, we will have been made to think.

Bring your problems to Cleveland and we can assure you they will be solved to your benefit and satisfaction. We have knowledge of a guest at our last Convention who had a problem solved whereby he has been able to cut his costs more per month than the amount of his expenses while attending the Convention.

Our program is so filled that there will be only two half days devoted to plant visitation. All of the men registered will be taken on a trip through one of this country's largest rubber and tire factories. Alternative trips can be made through Nela Park — the lamp Research Division of General Electric or National Carbon. It has been agreed that on the trip through National Carbon only such as are not connected with concerns making batteries, or radio equipment will be admitted. We shall call your attention to this again that none may be disappointed in their selections.

Since it will be necessary to have information relative to the selective trips as nearly as possible we hope that you will give this some thought before you arrive in Cleveland that you may register your choice at once.

We hope the guests feel as we do in the selection of the place for our athletic afternoon. One of the cities finest country clubs has agreed to accommodate us with the exclusive use of their facilities for the afternoon.

Here we may renew our golf tourney, run off that annual contest in baseball, with opportunities for many other sports including boating and swimming.

We cannot disclose at this time another attraction we are negotiating for, but I can assure you it will be well worth a trip to Cleveland to witness.

Do not overlook the fact that you will have two holidays for travel when coming to Cleveland, which ought to make it a doubly enjoyable affair if traveling by auto.

We hope the Branches are making the necessary preparations for a Branch exhibit or an individual exhibit of some Branch member. We wish to call attention to the fact that there has been provided ample space for a very ambitious contest.

It is needless to state that this exhibit will be in conjunction with the manufacturers' exposition to be held at the same time as our Convention. This will be accessible to all in the lower lobby of the Hotel, known as the Rainbow Room — a banquet hall large enough to seat 1000 people as one unit.

Our Exhibit Manager, Mr. R. T. Phipps has agreed to furnish information relative to the show in time to be included in this issue.

In case any of our readers require additional information relative to some point we have not made clear, we hope they will feel free to write the Publicity Committee, that we may have a chance to convince you you cannot afford to miss the "Best Convention Ever."

E. STEEN THOMPSON, *Chairman*
905 West Tenth Street,
Erie, Penna.

Transportation Arrangements for the Connvention

A concession of one and one-third fare on the Receipt Certificate Plan will apply for members and others attending the Convention. We have been assured of this concession by all important Passenger Traffic Associations entering Cleveland.

Tickets will be on sale at the regular adult one-way rate May 29th through June 3rd inclusive.

Be sure to ask for a Certificate Plan Certificate when purchasing your going ticket. Do not ask merely for a receipt.

Present yourself at your ticket office at least thirty minutes before train time when beginning your journey.

Certificates are not kept at all stations. It is suggested that you inquire at your home station and discover if the agent can issue a through ticket and certificate to Cleveland. If not, he will inform you as to the nearest station at which they can be obtained.

Immediately upon your arrival at Cleveland, present your certificate to our Mr. Wm. E. O'Berg, who has been authorized by the railroads to endorse all certificates.

The certificate will be returned to you after the Special Railroad Agent has validated same, as the reduced fare for the return trip will not apply unless properly endorsed.

Validation will continue during the days of the Convention so it will not be necessary to wait until the last day until your certificate is ready.

Return tickets must however be purchased before June 7th, but will be good for a return passage at any time within thirty days of date of sale of going fare.

More details relative to rate concessions will appear next month and again in the Official Program which will be mailed you soon after May 1st.

It is needless to state that as in the past the granting of this concession is contingent upon the presentation of 100 or more certificates.

LIST OF EXHIBITORS TO DATE

Booth No.	*Name of Concern*
1	Seymour Manufacturing Company, Seymour, Conn.
2	McGean Chemical Company, Cleveland, Ohio
3	Globe Machine & Stamping Company, Cleveland, Ohio
4	Maas & Waldstein Company, Chicago, Illinois
6	Nickel & Chromium Products Company, New York City
7	Nickel & Chromium Products Company, New York City
9	Norton Company, Worcester, Massachusetts
10	Norton Company, Worcester, Massachusetts
11	Udylite Company, Detroit, Michigan
12	Udylite Company, Detroit, Michigan
13	Udylite Company, Detroit, Michigan
14	Duriron Company, Dayton, Ohio
15	Detroit Rex Products Company, Detroit, Michigan
16	E. I. DuPont de Nemours Company, Wilmington, Delaware
17	E. I. DuPont de Nemours Company, Wilmington, Delaware
18	J. C. Miller Company, Grand Rapids, Michigan
20	Hammond Machinery Builders Company, Kalamazoo, Michigan
21	Hammond Machinery Builders Company, Kalamazoo, Michigan
22	Oakite Products Company, New York City
23	Bruce Products Corporation, Detroit, Michigan
24	Belke Manufacturing Company, Chicago, Illinois
25	Belke Manufacturing Company, Chicago, Illinois
26	J. B. Ford Sales Company, Wyandotte, Michigan
27	Williamsville Buff Mfg. Company, Danielson, Conn.
28	B. F. Goodrich Company, Akron, Ohio
29	Standard Electrical Tool Company, Cincinnati, Ohio
30	Carborundum Company, Niagara Falls, New York
31	Carborundum Company, Niagara Falls, New York
32	Kelly Plating Company, Cleveland, Ohio
33	N. Ransohoff, Incorporated, Cincinnati, Ohio
34	Columbia Electric & Mfg. Company, Cleveland, Ohio
35	Columbia Electric & Mfg. Company, Cleveland, Ohio
36	G. S. Blakeslee & Company, Chicago, Illinois
37	Lasalco, Incorporated, St. Louis, Missouri
38	Grasselli Chemical Company, Cleveland, Ohio
39	Grasselli Chemical Company, Cleveland, Ohio
40	Bullard Company, Bridgeport, Conn.
41	Special Chemicals Corporation, New York City
42	MacFarland Mfg. Company, Inc., Long Island City, N. Y.
43	MacFarland Mfg. Company, Inc., Long Island City, N. Y.
44	Egyptian Lacquer Mfg. Company, New York City
46	Electric Products Company, Cleveland, Ohio
48	Magnus Chemical Company, Garwood, New Jersey
49	Lake City Plating Works, Chicago, Illinois
50	Metal Cleaning & Fin. (Iron & Steel Pub. Co.,) Pittsburgh, Pa.

52 F. B. Stevens, Inc., Detroit, Michigan
53 F. B. Stevens, Inc., Detroit, Michigan
54 Matchless Metal Polish Company, Chicago, Illinois
55 Puro Products Company, Cleveland, Ohio
56 Hanson Van Winkle Munning Company, Matawan, N. J.
57 Hanson Van Winkle Munning Company, Matawan, N. J.
58 Hanson Van Winkle Munning Company, Matawan, N. J.
102 Kocour Company, Chicago, Illinois
104 Anderson & Sons, Springfield, Massachusetts
105 Roxalin Flexible Lacquer Company, Elizabeth, N. J.
106 Lea Manufacturing Company, Waterbury, Connecticut
Parlor "F" Branch Society Exhibits
Lobby "Metal Industry", New York City

Committee on the selection of

Prize Awards for Papers

The Society will award two medals this year for papers:

1. The Founders Gold Medal, to be awarded to the author of the best paper by any *active* member of the Society that is presented to an Annual Convention or to a Branch meeting, and is published in the MONTHLY REVIEW.

2. The American Electro-Platers' Society Medal, to be awarded to the author of the best paper by any person, whether or not a member of the Society, that is presented to an Annual Convention, or to a Branch meeting, and published in the MONTHLY REVIEW.

The following have been appointed to this committee: Dr. William Blum, Chairman; W. J. R. Kennedy; Dr. A. K. Graham; W. S. Barrows; F. C. Mesle.

T. F. SLATTERY, *President*

PROPOSED AMENDMENTS TO THE CONSTITUTION

of the

AMERICAN ELECTRO-PLATERS' SOCIETY

The Baltimore-Washington Branch has given notice that it will sponsor a motion to amend our Constitution after giving consideration to the recommendation of the Auditing Committee to the Twenty-Third Annual Meeting, June 11, 1935. "That two Amendments to the Constitution be framed regarding the Editor's, and the Secretary-Treasurer's salary, in order to save more extra work by the Auditing Committee in the future, and have it settled once and for all.

Purpose.—The purpose of the proposed amendments is to provide for the employment of a full-time Executive Secretary who shall perform the present duties of the secretary, treasurer and editor, and other duties pertaining to a headquarters office of the Society. Preliminary estimates indicate that the total expense involved, including traveling expenses, would not exceed $3000 per year. At present about $1000 is being expended for these purposes. It is believed that the remaining $2000 can be obtained from increases in (a) membership (b) advertising and (c) subscriptions to the Research Fund, that will result from the proposed reorganization of the work.

Amendments

(In the following amendments, the significant changes are underscored).

(1) Amend Article III, Section 1, to read:

"The officers of the Supreme Society shall be a President, a Retiring President, a First and Second Vice President, an *Executive Secretary*, and an Executive Board."

(2) Amend Article III, Section 2, to read:

"The Executive Board shall consist of all the *elected* officers of the Society."

(3) Amend Article IV, Section 4, and Section 5, to read:
(This is entirely revised)

"It shall be the duty of the Executive Secretary to perform the duties heretofore assigned to the Secretary-Treasurer and the Editor, and such other duties as may be assigned to him by the Executive Board."

He shall keep an accurate report of the proceedings of each meeting of the Supreme Society, and of the Executive Board. He shall take charge of all funds of the Supreme Society, pay all bills properly presented to him for payment, with the approval of the President, and deposit the funds in such a manner as the Executive Board may direct. He shall receive all moneys paid by the Branch Societies, and give receipts therefore. He shall keep an itemized record of all receipts and expenditures, and shall have his accounts ready for auditing at each annual meeting, or at any time the Executive Board may deem advisable. He shall be in charge of the Bureaus of Information, Employment and Education. He shall take charge of and preserve all papers and documents pertaining to his office.

He shall preserve in good condition all papers sent to him by any member or by any Branch Society, and attend to the editing and publishing of such matter as the Society may direct. He shall take charge of all literature belonging to the Society. He shall have power to appoint members of the Editorial Staff. At the Annual Convention he shall give a report of his activities.

His salary shall be fixed by the Executive Board, subject to its approval by the Supreme Society in the annual budget submitted by the Executive Board. He shall furnish the bonds required by the Executive Board.

(4) Amend Article IV, Section 6, by changing in line 9, words, "Secretary-Treasurer" to "*Executive Secretary,*" and by adding the following paragraph:

NEW

"The Executive Board shall submit to the Annual Meeting of the Supreme Society a budget of the estimated receipts and expenditures for the ensuing fiscal year. After this or an amended budget has been approved by the Supreme Society no expenditures for any items shall be increased by more than twenty (20) per cent. without the approval, by letter ballot of the Supreme Society. If at any time the receipts are less than those estimated, the Executive Board shall endeavor to decrease the expenditures accordingly."

(5) Amend Article V, Section 1, to read:

All officers of the Society, *except the Executive Secretary,* shall be elected and their terms shall be for one year. *The Executive Secretary shall be appointed by the Executive Board, and shall continue to serve until his successor is appointed and qualified to serve by the Executive Board.*

(6) Amend Article IX, Section 1, and Section 5, by substituting "Ex ecutive Secretary" for "Supreme Secretary".

(7) Amend Article XI, Section 1, and Section 4, by substituting "Executive Secretary" for "Supreme Secretary", and Section 6, by substituting "Executive Secretary" for "Editor".

T. F. SLATTERY, *President*

The Application of Mesle's **Chord Method** *in the Measurement of the* **Thickness** *of* **Electrodeposits**[1, 2]

by

W. Blum[3] and A. Brenner[4].

I. INTRODUCTION

In recent years, the tendency has been to specify the *minimum* rather than the average thickness of electroplated coatings. The average thickness has generally been computed from the weight of metal deposited on or stripped from a piece of known area. Metallographic examination has been most commonly employed for determining the thickness at one or more points on the surface. This usually involves plating another metal, such as copper, on the surface to be tested, or else clamping a metal strip against it. The article is then cut through at the desired point, the section is polished, and the thickness is measured under a microscope. This procedure requires considerable time of skilled operators, and the tested specimen is usually destroyed in the process.

The dropping method that was described by Clark, and by Hull and Strausser, is useful for testing the local thickness of zinc and cadmium coatings. In the *Metal Industry* for August, 1935, F. C. Mesle described an ingenious procedure to which the name "chord method" has been given. As he applied it only to silver-plated teaspoons, it appeared desirable to determine its accuracy with various metal deposits on flat and curved surfaces. The results are summarized in this paper.

[1] Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.

[2] A more detailed report of this investigation, including the interpretation of several mathematical formulas, was published in the Journal of Research of the National Bureau of Standards, as Research Paper 866, (February, 1936). Copies of this paper can be obtained from the Superintendent of Documents, Washington, D. C., at 5 cents each. (Stamps not accepted.)

[3] Chemist, National Bureau of Standards.

[4] Junior Chemist, National Bureau of Standards.

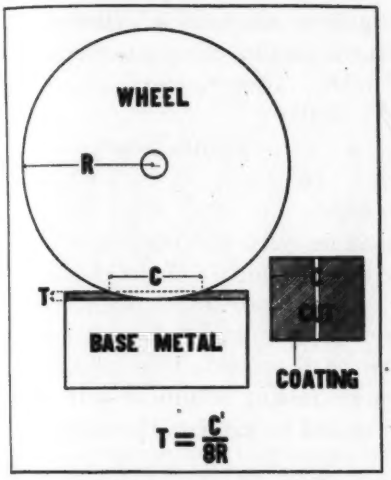

FIG. 1—Testing a coating on a plane surface with a grinding wheel.

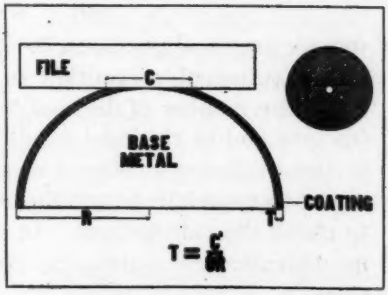

FIG. 2—Testing a coating on a spherical surface with a file.

II. PRINCIPLES INVOLVED

Two useful ways of applying this method are illustrated in Figures 1 and 2. The former shows a coating on a flat surface that has been just cut through with a grinding wheel of known radius; and the latter shows a coating on a spherical surface that has been just cut through with a flat file. In either case it is necessary to know only R, the radius of the wheel or of the curved surface, and C, the width of the cut (which is the "chord" of the arc covered by the cut), in order to calculate T, the thickness of the coating, according to the equation

$$T = \frac{C^2}{8R}$$

This calculation may be illustrated by typical examples.

(a) On a plane surface — Suppose that when the coating on a flat surface is just cut through with a grinding wheel having a radius of 4 inches (that is, an 8-inch wheel), the width of the cut is 0.2 inch. Then

$$T \text{ (thickness)} = \frac{C^2}{8R} = \frac{(0.2)^2}{8 \times 4} = \frac{0.04}{32} = 0.00125 \text{ inch}$$

(or, for practical purposes, 0.0013 inch).

(b) On a curved surface — Suppose that on a cylindrical tube with a radius of 2 inches, when the coating is just cut through with a file, the width of cut is 0.1 inch. Then

$$T \text{ (thickness)} = \frac{C^2}{8R} = \frac{(0.1^2}{8 \times 2} = \frac{0.01}{16} = 0.000625 \text{ inch}$$

(or, for practical purposes, 0.0006 inch).

The principal precaution in making such calculations is to check the number of decimal places in the square of the decimal fraction and in the final result. If the approximate magnitude of the thickness is known in a specific case to be, for example, either thousandths or ten-thousandths of an inch, this will serve to check the calculations. In routine testing of similar articles, no difficulty will usually be experienced in making the calculations.

In general, an accuracy of about 10 percent of the thickness is desirable, and is feasible for coatings at least 0.0002 inch thick. To obtain this accuracy, it is necessary to measure the width of cut with a precision of about 5 percent. The radius of the wheel or object should be measured with a precision of about 2 percent.

III. METHODS OF APPLICATION

The simplest way to test the coating on a curved surface is to cut through it with a fine, flat file, for example a No. 6 file. The most important precaution is to make sure that the file does not "rock", that is, the cut must be made in a plane. For an article like a spoon, this condition can be met by rubbing the bowl of the spoon on the file while the handle is kept from turning. In general, rocking can be prevented by holding the article in a vise, and having a rigid support a few inches away upon which the file rests while it is moved across the surface to be tested.

The filing is continued until the base metal is just exposed. If the width of exposed base metal is not more than about 10 percent of the width of the cut, it is not necessary to make any correction for it. If the contrast between the coating and base metal is not sharp, it can be increased by treating the cut surface with an appropriate reagent. If, for example, a neutral saturated solution of copper sulphate is applied to exposed steel, it produces a film of copper on the steel and makes a sharp contrast with a nickel coating. When the base metal is copper,

brass or nickel-brass ("nickel-silver"), it should be slightly etched with a solution of chromic acid and sulphuric acid, which increases the contrast.

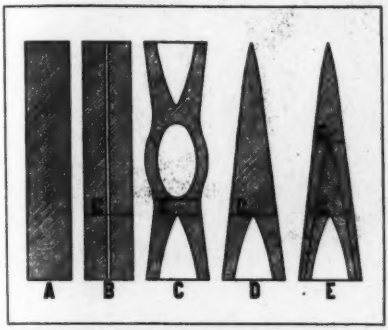

FIG. 3—Appearance of typical cuts with a wheel on a flat surface.

A—Parallel cut that has not exposed the base metal.

B—Parallel cut with slight exposure of base metal.

C—Cut produced on a surface that is not quite plane, exposing base metal at intervals. The thickness "T" can be computed from the chord width "C" wherever the base is just exposed.

D–Tapered cut produced by slightly inclining the plate.

E—Tapered cut on plate with a composite coating. The thickness of each coating may be computed from the chord width where the next lower layer is just exposed.

The best way to cut through a coating on a nearly flat surface is with a precision grinding wheel, such as is available in many machine shops. If the base metal is steel, the object may be held on a magnetic chuck. Otherwise a mechanical clamp must be used to hold it rigidly. If the wheel is brought down so as to just cut into the surface, and the latter is then moved parallel to axis of the wheel, a cut with parallel edges, like that in Fig. 3A, is produced. If then the base metal is not exposed, the wheel is lowered slightly and another cut made, until finally the base metal is exposed, as in Fig. 3B.

Practically, most "flat" surfaces, especially on cast metals, are not perfectly plane, and a cut like that in Fig. 3C may be produced. If a nearly flat surface is slightly tilted, for example by putting a sheet of paper under one edge, the cut tapers, as in Fig. 3D. In such a cut, the width, C, where the base metal is just exposed, is used to calculate the thickness, according to the above formula. If the cut is like that in 3C, the thickness can be computed from the width wherever the base metal is just exposed. If, as in Fig. 3E and Fig. 4, a composite coating is tested, the thickness of each layer can be computed from the width of cut where the next lower layer is just exposed.

It was found that for testing coatings on hard metals such as steel, a fairly fine grinding wheel, about a 120-grain, is most satisfactory. For softer base metals, or for coatings containing a layer of copper, a coarser wheel, about a 90-grain, is preferable.

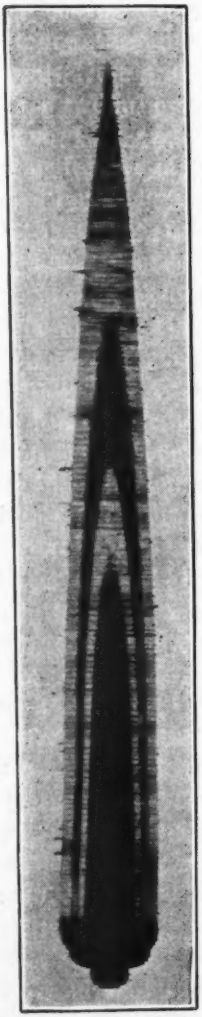

FIG. 4—Actual cut on a composite nickel-copper-nickel coating on steel. The inside dark area is steel (coated with copper) and the next dark area is the intermediate copper layer.

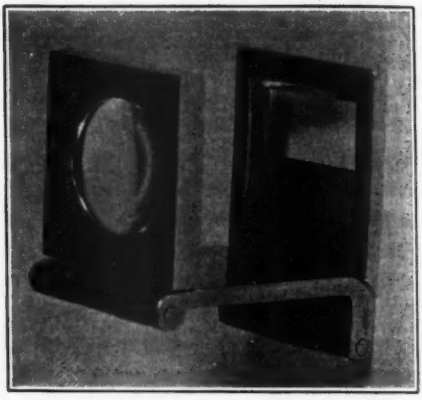

FIG. 5—Pocket lens and scale (usually metric).

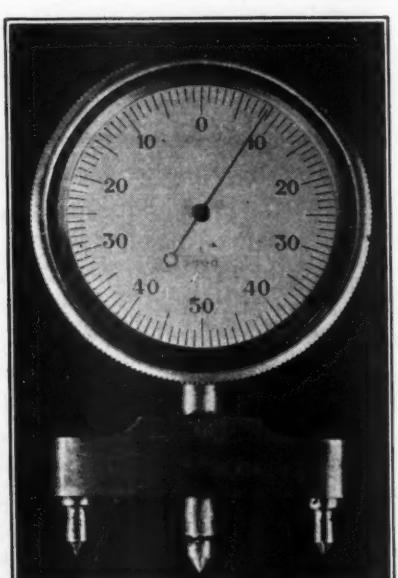

FIG. 6—Typical spherometer for measuring curvatures of surfaces.

The wheel should run at a high speed, around 3000 rpm, and must be dressed with a diamond occasionally to keep it true. Small changes in radius caused by this dressing are not important, but the radius should be measured often enough to know its value within say 2 percent (that is 0.1 inch in a radius of 5 inches).

It is not necessary to use a microscope to measure the width of cut, which, for most cases to which the method is applicable, will be between 0.1 and 0.3 inch. A pocket lens and a thin steel scale, graduated to 0.01 inch, will usually be satisfactory. A combination of lens and scale, as shown in Fig. 5, is convenient. (If the graduations are in millimeters, the measurements can be converted to inches by multiplying by 0.04 or dividing by 25).

It is not always possible to measure the radius of curvature accurately, especially on an article of irregular shape, where the radius varies at different parts. A radius up to 1 inch can usually be measured with a "radius gage", sets of which are available in most machine shops. In other cases templates can be prepared, such as were employed by Mesle for measuring the curvature of spoons. The most general method for measuring the curvature of any surface is by the use of a spherometer, one type of which is shown in Fig. 6. It is possible to have the dials graduated to read directly the radius of curvature. If not, the latter can be computed from the reading, which is usually in thousandths of an inch.

IV. ACCURACY OF THE RESULTS

The reliability of the chord method was determined by comparing its results with the average thicknesses computed from the weights of deposit on specimens plated with special precautions to produce uniform distribution. In addition, the thickness on some of the specimens was determined by measurement of metallographic cross-sections. Many of the flat specimens were taken from those plated for the exposure tests on steel or for the new exposure tests on non-ferrous metals. In fact, this

method has proved very useful as an additional check on the thickness and distribution of these coatings.

The conclusion from a large number of tests was that the method is almost always accurate to about 10 percent on coatings not less than 0.0002 inch thick. The tests included nickel and composite copper and nickel coatings on steel; zinc and cadmium on steel; nickel and chromium on copper and brass; and nickel on zinc-base die castings; and silver on nickel-brass teaspoons. The results on spheres and cylinders were nearly as accurate as on flat surfaces. The method is not applicable to the very thin coatings of chromium, about 0.00002 inch, that are commonly applied over nickel deposits.

V. CONCLUSION

It is believed that the chord method is sufficiently promising to warrant its thorough trial, both within the plant to check the plating cycles, and by purchasing officers to check deliveries of plated materials. It is hoped that such tests will be made by many persons, in order to find out whether the method warrants inclusion in formal specifications.

The method is very simple and rapid, and should be especially useful when a large number of similar samples are to be tested. One of its advantages, particularly within the shop, is that in the testing, the base metal is not usually damaged much. Hence the tested articles can frequently be salvaged by stripping, polishing, and replating. This method is therefore especially promising for testing large articles, such as bumper bars.

The authors desire to thank F. C. Mesle of Oneida Community, and C. Kasper and P. W. C. Strausser of the National Bureau of Standards, for advice and assistance during this investigation.

Reading on Plating Racks

Before: Detroit Branch A. E. S. December 6, 1935

Years back before the advanced strides Electroplating has made in the past few years, parts to be plated were strung on copper or iron wires with no thought or regard to the ampere carrying capacity or the position of the pieces in the tank. As a result, the back side of the part would sometimes receive a heavier plate than the front side where it is most needed, and the parts would have to remain in the tank a longer period of time because of the inefficiency of the wire to carry the ampere current. This practice of wiring, antique as it is, is still being done in many shops. Then, there is the homemade rack. While it is most certainly an improvement over wiring, yet, these racks are still inefficient. Most homemade racks are made of very light wire; the tips are permanently assembled to the rack; the racks are not insulated; and the result is insufficient ampere carrying capacity and shading of the plated parts where they are close to or touching the spine and with no regard to the position of the part in relation to the anode.

Today, in making a proper plating rack the following suggestions should be considered: First, will the spine be heavy enough to carry the ampere current? Second, what is the proper position to hang the work in relation to the anodes in order to put the plated deposit where it is most wanted? Third, the proper type or design of tip to make racking and unracking a quick and simple operation. Fourth, the proper kind of insulation on the stem proper, and, if the nature of racking will allow, for the complete insulation of the tip, except that portion needed for contact, or whether the whole tip must be left exposed. A rack used in copper, brass, nickel, cadmium or zinc can be of very simple design and light in construction. For die cast nickel plating, the rack must be somewhat heavier, depending on the size and weight of the article. The racking should be of positive spring or tight contact. For chromium plating, the rack spine should be of copper because of its high efficiency for ampere carrying capacity, and the tips of heavy positive spring or tight contact. Also, very particular attention must be paid to the position of the work when in the tank and that contact is sufficient to carry on equal distribution of current all over the plated part. In many cases, this is not possible and the result is burnt work. This burning of the work can be overcome and in many cases is necessary by the addition of burning wires. The chrome rack should also be insulated. There are, today, on the market, many kinds of insulating lacquers, but a special chrome rack rubber insulation will outlast any of these lacquers.

I am going to pass out amongst you samples of racks, samples

of various insulations, and samples of exposed and insulated tips, insulated by the anodic rubber process, as are the nuts and washers. Where the entire tip is insulated, the rubber can be removed, (only enough removed for necessary contact), by either cutting with a knife, by filing, or application to a grinding wheel. In these samples I have passed out amongst you, there are three kinds of insulation. The first is handwrapped insulation, recognized by its dull and slightly rough surface. The second is a "Duo-Cote" insulation, smooth and shiny in appearance and so named because there is a covering of anodic rubber over the handwrapped rubber. This kind of insulation is highly acceptable because solutions and rinses wash off very quickly, eliminating possibilities of contamination through this source. The third is a chrome rubber insulation with a second coating over it. This chrome rubber is of a different composition than the others. The covering supplied on nickel racks is not recommended for chrome use. It might stand up in chrome for a time, but not for very long, depending on the severeness to which is it subjected.

An important feature regarding the insulation on all these samples is the adhesion of the rubber to the metal. The racks are processed before the rubber insulation is applied, and during the vulcanizing, the rubber becomes bonded to the metal. There are no air pockets between the rubber and the metal. If this were so, the bubbles would soon break out and the metal would become exposed, and cause further damage to the insulation at that point.

A new idea in ordering racks has met with the approval of some users. They order a quantity of insulated stems with the desired cathode hook. The stems are not drilled or tapped when furnished by the factory. When a rack is needed for a new job, the customer orders the style of tip needed, which can be supplied very quickly by the factory. Then the customer drills and taps the racks to his own desired spacings.

With the proper design of insulated rack and proper tip, and making the most of alloted space in the tank, the plater can often save the necessity of an extra tank or a larger generator and still increase his production. The insulated rack requires less current; there is a tremendous saving in anode costs; the plating is applied only where needed and that is, on the work; there is no shading or thin spots and no detraction of plating from the parts onto the rack.

This covers about most there is to say on this subject. If there are any questions which any of you are desirous of asking, I will try to answer them for you.

Roy A. Johnson,
Detroit District Manager
for Belke Mfg. Co.

Improvements *in the* Brass *Industry*

D. K. CRAMPTON

Read at Bridgeport 1935 Convention

THE subject is "Improvements in the Brass Industry", which is such an exceedingly broad subject that it could not possibly be treated in a short time. I shall confine myself to improvements in the strip and sheet rolling part of the industry.

It seems quite proper to start with developments in the casting shop. Of course, the big change that has come about in the casting of brass in recent years is the advent of the electric furnace. The furnace mostly used today is the Ajax Wyatt furnace which is an induction type and gives very good results for most routine uses. The Ajax high frequency induction furnace is used to a much less extent, particularly for high melting point alloys and for materials that are made in relatively lesser quantities.

In the old days, most brass and copper alloys were melted in pit fires and crucibles, the usual charge being about 200 or 250 pounds. Those small charges gave rise to certain difficulties which the electric furnace has overcome.

In the first place, it was very difficult to get uniform charges and to keep them uniform. The materials, therefore, varied very greatly in analysis and in various physical properties. Crucible melting was also slow and quite expensive, and the working conditions were very bad. It was hot and there were heavy fumes, all of which was not conducive to best results.

A further difficulty was the fact that due to the slowness of the melting, a great deal of gas was absorbed by the metal, resulting in considerable unsoundness. The molds that were then used were not as good as they are today. They were usually two-piece molds banded together. They did not always fit too well. The iron used in the molds was not as good as it is today. They frequently cracked and scored up, giving relatively poor surfaces on the castings. The mold dressings had not been studied as thoroughly as they have been in recent years, which also contributed to poor surfaces on the castings.

With the advent of the electric furnace, many of these things

were automatically corrected. For instance, the smallest of the charges of electric furnaces was about 600 pounds. Later they increased the size to 800, 1,000, 1,500 and now 2,500-pound furnaces, which are quite common, and even 3,500-pound furnaces are making their appearance. With a larger charge it is much easier, of course, to get a uniform analysis of material, and the losses due to melting are very much lower. The zinc loss due to volatilization is only a fraction of what it was in the old furnaces or pit fires, and the skimmings loss is very much lower.

The molds, as I said, have been greatly improved. They usually are of book or hinge type, banded together with hooks. They are held in a vertical position instead of slanting, which means the molten metal does not impinge on the mold wall. All of this tends to give a much more uniform, clean material suitable for rolling in fabrication. One of the rather recent developments which has gained a foothold is the use of water-cooled molds. This is particularly useful in the casting of heavy cakes for hot rolling, such as, perhaps, three or four inches thick, and cakes weighing anywhere up to 1,500 pounds. Such molds are very readily tested and kept in excellent condition. As compared with the old style mold, and the uniformity and cleanliness of the cast, the surfaces are greatly improved. Naturally, the material rolled from such good castings is likewise very much better.

Passing over now to the subject of rolling and mill equipment, it is interesting to note the vast improvements that have taken place in that field. Formerly, almost invariably two-high mills were used. They were relatively large diameter rolls for the breaking down into intermediate operations and smaller rolls for finishing. Mostly they ran quite slowly. Linear speeds of 80 to 120 or possibly 150 feet per minute were the order, and the production was relatively low compared with what we have today.

The earlier roll bearings were a babbitt, later of bronze, and, as mills got heavier and the pinches got heavier, of course it was necessary to develop better bearing materials and, along with that, better lubricants. The lubricant first used on the roll necks was a soft stick-on grease, as it was called, and you might say was slobbered on. A great deal was wasted. It was not a particularly efficient lubricant in the first place, or a

particularly efficient way of applying the lubricant. A great deal of heating resulted when anything like a heavy pitch was taken, and heat in a rolling mill is a very bad thing. It results in warping of the roll and distortion of the metal that is produced. It is exceedingly difficult to get uniform gauge metal free from belly, as we call it, under such conditions.

Later the stick-on grease was supplanted by a hard grease, and considerable improvement resulted. A still further development in that line was automatic lubrication, where a liquid grease under pressure was brought through a small pipe line to the roll neck, and by a timing mechanism a measured quantity of grease was put on the neck at certain intervals, perhaps every fifteen minutes or every twenty-five minutes, as the case might be. With such a lubrication system, the amount of grease used was greatly cut down; the upkeep on machinery was greatly reduced; the temperature of the roll was lowered with the lowering of the temperature of the roll necks; it was very much easier to get uniform gauge and flat material.

A still later development was fiber bearings instead of bronze bushings. It is a very bad thing, in a way, for the copper people, because one of our nice outlets for copper is in bearings, but nevertheless these fiber bushings are excellent. One of the very nice things about them is that they use water for a lubricant and not grease. We have a number of these fiber bearings in our mills, and they are performing in beautiful fashion. The necks stay in excellent condition. They do not score and they remain cool and, therefore, the rolls stay in shape very nicely.

Perhaps the best development in this line is the use of roller bearings. They are coming into use on high-speed finishing mills particularly. In fact, it is the use of the roller bearing that admits of high-speed finishing today. With bronze bearings, for instance, it would be impossible to run the speeds that some of these mills run because the temperature generated would be excessive and it would be absolutely impossible to hold the shape of the rolled metal. For instance, we are running a finishing mill with roller bearings today at 600 feet per minute, which is ever so much faster than we ever could run any mill with the old type bearings and lubrication.

Speaking of mills, it is in order to refer briefly to developments in the type of the mill, from the two-high mill it was a short

step to the three-high mill, which is an easy way of getting a reversing action, and then in recent years two new types of mill, the four-high and cluster, have made their appearance. The four-high mill consists of two relatively small working rolls backed up by two relatively large back-up rolls. The idea of this is that the small diameter rolls require very much less power to roll, but being small diameter rolls, they are not stiff and require being backed up by something that is stiff in order to keep in good shape on the metal roll. Much the same idea is obtained with the cluster mill, where they have the same two small working rolls, but each of the small rolls is here backed up by two large diameter backing rolls.

The lubricant used on the metal itself (I am not talking about the lubrication of the roll necks, but the lubrication of the metal being rolled) is something that has been advanced greatly in late years. Formerly it was swabbed on. The roller had a little pail of grease or oil, and he had a thing that looked like a dish mop. He would swab the oil on the metal top and bottom, and if he felt good that day he would get plenty of oil on it, and if he had been out late the night before he did not get as much on it, and if somebody was telling him a story on the side perhaps he did not get any on it. There have been several mechanical devices developed which automatically give exactly the right amount of oil on both sides of the sheet—over the entire length. This is a distinct advantage in maintaining a uniform gauge and a nice surface.

In earlier years the rolls were almost invariably of cast iron, chilled cast iron, and even with the very nicest grinding the surface was not dead smooth in the strict sense of the word. In later years the use of polished alloy steel rolls has come to the front quite a little, and with such rolls it is possible to obtain a very much higher luster, a very much closer texture on the surface of the sheet than formerly could be obtained. This, of course, is of great interest and help to people like yourselves, who are interested in the finishing of materials, plating or other types of finishes.

Another development that is gradually coming about is the use of shorter rolls. In the old days, the rolls were prevailingly very much longer than the diameter. For instance, the length of two to two and one-half times the diameter was quite common.

Even with a roll twelve inches in diameter and twenty-four or twenty-eight inches long, it would not seem a great deal of bending would take place. Nevertheless, such rolls do bend and bend very appreciably. That is one of the factors that enters into the difficulty of holding the gauge of the metal, particularly the gauge across the sheet. The tendency nowadays is to roll with very much shorter length in proportion to the diameter, and nowadays perhaps the average is more like a length of one and one-half times the diameter rather than two or two and one-half times the diameter. The shorter the roll, the less the tendency to bend, and the more accurate the gauge can be held. With these slides, I will illustrate:

(*Slide*) These are diagrammatic representations of different types of mills I have referred to. This is the type I call two-high mill, relatively large diameter working rolls requiring relatively great expenditure of power. In the four-high mill the actual working rolls are very small compared to the usual two-high mill. To effect the same reduction of thickness as was effected up here, a very much lower expenditure of power is necessary. This is because of the lesser amount of metal being worked at any particular instant. These rolls naturally are not very stiff, and they are backed up by these large diameter backing rolls which prevent springing in this position.

The three-high mill is rather an intermediate thing. The central roll is usually relatively small, and you get somewhat the same action as you get here, the particular advantage of this being that where you want to make several passes, the metal can be put through here and back on this pass, and that can be done several times if necessary. The cluster mill is very similar in action to the four-high mill, except here we have the small working rolls and four backing-up rolls. This mill was originally thought to be a much better design than this, because it seemed it would be much easier to keep these working rolls in good condition and properly backed up. As a matter of fact, the tendency today is decidedly toward the four-high mill rather than the cluster. It is a much simpler mill, and with the modern construction it is a simple matter to keep these things lined up and in good working condition.

(*Slide*) The type of mill which I forgot to mention a moment ago but which has come into use in recent years is the Steckel

mill. We have the same two small working rolls. In this instance they are exceedingly small. On some finishing mills, for instance, they might be only an inch and three-quarters in diameter. Here are very large backing rolls to keep them stiff. There are two arbors to coil your metal. You might start with metal over here and run it through in this direction. Now the particular feature of this mill is not only that it has small working rolls, but they are idle. They are not driven. The metal is literally pulled through the rolls and the squeezing action takes place as usual and there is no driving action. The metal is run through here nearly all the way, but there is one turn left on this mandrel and then it is run back this way, and again reversed and it goes back and forth perhaps thirty or forty times, taking off a very small amount each time but effecting a very large total reduction. The advantage of this mill as compared to any of the other types shown is that you can get a very large total reduction with very accurate and very uniform gauge. The makers of the mill at first claimed great things for the structure of the material, indicating that the physical properties and structure could not be obtainable with ordinary rolling. As a matter of fact, I do not think that is justified, but from the mechanical standpoint, there are some very decided advantages.

A very recent development in a kind of combination of casting and rolling is the Hazelett mill where molten metal is poured between two rolls and comes out a relatively thin rolled strip. The metal freezes on each roll and comes together and is squeezed so it has a combination of freezing and hot rolling. This thing is very new. One steel mill, one nickel mill, and one brass mill have been developing it for the last year or so, and it is just about in the commercial stage now. Reports are that it is very successful and quite a revolutionary step. The obvious advantage of a thing of this kind is naturally that instead of casting a bar an inch and a quarter thick and requiring a lot of cold rolling operations, the metal comes out something on the order of an eighth of an inch thick and can be finished off very rapidly. Also, very long coils can be cast about as long as is consistent with the weight of the molten metal available. That is a very decided advantage in itself.

(*Slide*) This will illustrate some of the points I spoke about on lubrication. These are the old types of either bronze or

babbitt or even fiber bushings. The grease was swabbed on these necks and water was sprayed on them to keep them cool. The development of the hard grease came later. There is a grease box here, pressed against the roll.

Let us talk for a few minutes about annealing and pickling. The annealing and pickling, especially, of finished material has developed very rapidly in the last few years. Formerly almost all annealing was done in batch-type furnaces, usually poorly constructed, fired with coal or oil for intermediate operations, and with wood for finishing operations. The atmosphere was not controlled. It was whatever it happened to be, usually fairly oxidizing, very frequently containing much sulphur, and the surface of the sheet was, as a result, far from clean and far from presentable in many cases. The temperature control was not too good and variation in grain size and temper and, therefore, physical properties of metal was exceedingly great.

Recently, continuous furnaces of belt-type or chain conveyor-type have come into use, particularly for finishing anneals and the uniformity of structure and physical properties is markedly greater. The grain size, particularly, is interesting to people having to do with finishing operations because it largely determines the ease of finishing and the quality of the surface that is to be obtained by buffing or other finishing operations.

Bright annealing is something that is being studied a great deal and is coming into use. In these furnaces an atmosphere of partially combusted gas is frequently used. There is a process using Methanol and there are other things being studied. The bright annealing of copper is a relatively simple matter. Copper can be bright annealed quite easily in a steamed atmosphere, but steam is strongly oxidizing to brass. In brass it is necessary to have a high CO atmosphere, complete absence of water vapor, and in particular the time factor is of all importance. In an atmosphere which will give a bright anneal on brass in a matter of seconds, it would be quite badly oxidizing if the ordinary batch-type anneal were resorted to, where perhaps a half hour and an hour and a half was the time in the furnace. Of course, to take advantage of that thing it is absolutely essential that a strip-type of anneal be used where the metal is run through the furnace continually in a strip so that the time actually at the temperature is very, very short.

The pickling of brass, likewise, has progressed considerably. In the old days the pickling was all done in batch-type open tubs, the coils being opened up partially and agitated by hand. The tendency nowadays is to have a continuous strip running through the pickle and over rolls then through hot and cold water, and over steam dryers and then it is coiled up.

(*Slide*) I am going to show just two pictures of grain structure. They are not as good as I wanted to have them. I loaned some slides and did not get them back in time. This is fairly typical of a fine-grain sized material obtainable easily with modern furnaces with accurate temperature control and conveyor mechanisms.

(*Slide*) This is more typical of what you used to get in the old days with the old type furnaces, where control was not so good and where metals were annealed in batches. In parts the load would be like the first slide and in other parts it would be like this.

(*Slide*) Ericksen cups are very frequently used to control grain size. When they are punched out, the varying grain size makes a varying roughness of surface from smooth up to coarse. That is the same thing that is found when metal is worked in a press or otherwise, and it is the reason why some material is much harder to finish than others.

(*Slide*) This is a diagrammatic representation of a modern conveyor annealing furnace with an atmosphere control. There is a hood here which comes down over the belt. The gas tends to stay up and stay in the furnace here. The work on the belt goes through first the annealing furnace, along the cooling chamber, and is discharged at the floor level. In a furnace of this type, material can go through and be annealed to any degree of softness desired, cooled down in the atmosphere, come out bright and clean and dry. This is typical of the pickling operations I mentioned where the sheet is unwound and goes down through a tank. Here is cold water and hot water. It goes over the coils and is wound up.

I have some more data here that I was going to talk about, but I am afraid the meeting was started late and there are a number of other speakers and I shall be easy on you and stop at this point.

Important Facts *governing* Cyanide Plating

By JACOB HAY
Read at Chicago Branch Annual Meeting

DURING the last four years that I spent in the plating industry as a practical plater, it was my duty to operate Hot Cyanide Copper Solutions on a very large scale. The production schedule at times was very heavy; therefore the conditions under which this production had to be produced were not the very best. At any rate, the writer was soon to find out that operating a Hot Cyanide Copper Bath was not as easily accomplished as it appeared, if specifications on deposits had to be met. The time was limited to meet these specifications. For instance, if one was called upon to deposit 0.0005 of copper in 30 minutes, this schedule had to be maintained 24 hours or lose out on production.

The following are the factors which must be followed if one wants to operate a copper cyanide bath successfully:

Analyze the solution daily for copper, free cyanide; and once a month for carbonate.
The temperature must be kept constant at all times.
Current Density cannot vary at any time.
The cyanide is a very important factor.

A few years ago, while I was employed by one of the largest gas and radiator cap manufacturing companies, we were plating gas and radiator caps. Every so often, we would get a complaint that we did not have enough copper on some parts, although we, ourselves, checked daily and we were sure that we were right. But after we started to run a series of real tests, we soon discovered where our mistake was. Tests were run in a copper cyanide bath, the formula for which will be shown on following slides.

Previous tests made on caps plated in this solution showed considerable variation in the thickness of the deposit. The anomalies or irregularities that were presented from time to time were difficult to define and therefore the only explanation that could be offered for it, was a difference in contact between

the caps and their respective holders. Consequently, it was decided to run several racks and eliminate, as far as possible, the question of contact and determine what variation in the deposit was produced under the best conditions.

Flat steel discs (3-11/16" in diameter and 1/16 of an inch thick) with a hole at the center 5/32 of an inch in diameter, were secured for this test. The racks were rubber coated and each held 14 discs, 7 facing the inside anodes and 7 the outside. The discs were fastened directly to the prongs of the rack with a screw and a washer. Each rack was run along with other work in the tank. The current density was calculated by the amount of surface that was in the solution at one time.

The chemical composition of the cyanide copper solution at the time the test was run was as follows:

	Gms/Liter	*Oz/Gal.*	*Normality*
Copper Cyanide	76.5	10.2	.85 Copper
Free Sodium Cyanide	67.5	9.0	1.38
Sodium Carbonate	28.5	3.8	0.54

Three racks or series were run under the following conditions:

Series	I.	II.	III.
Temperature of Solution Degrees F.	105	108	108
Voltage	3	5	2
Total Amperes	700	2550	450
Total Load in Tank Sq. Ft.	70	55	70
Current Density, Amps/Sq. Ft.	10	46	6.5
Time in minutes	20	20	20

Series III did not produce a good adherent plate on all discs.

Each disc was weighed before and after plating and the difference in weight is the weight of the copper deposited. From this weight, the number of ounces of copper per square foot is calculated, assuming that the plate is uniformly distributed over the front, the back and the edge. The total area of each disc is .152 sq. ft. which includes the edge and makes allowance for the small section at the center which received no plate. The results of these tests are given in the following tables:

COPPER DEPOSIT IN GRAMS PER SQUARE FOOT

	Series I.		**Series II.**		**Series III.**	
	Inside	*Outside*	*Inside*	*Outside*	*Inside*	*Outside*
1. Top	6.43	6.27	8.86	8.94	2.67	2.55
2.	6.35	5.96	9.05	8.46	2.48	2.36
3.	4.77*	5.91	Lost	8.67	2.46	2.36
4.	6.02	5.72	8.75	8 52	2.48	2.29
5.	5.79	5.51	8.27	8.04	2.47	2.27
6.	5.75	5.49	8.29	8.01	2.48	2.35
7. Bottom	6.04	5.88	8.61	8.50	2.55	2.46
Avg. Side	6.06	5.82	8.64	8.45	2.51	2.38
Avg. rack on both sides		5.94		8.55		2.38

* *Note*: This result is not included in the averages. No explanation for this discrepancy can be made and it has not been given any consideration in the following conclusions:

The three series show the following efficiencies: Series I. 75%, series II. 24%, and series III. 48%. It is evident that for this solution two volts (6.5 amps/sq. ft.) is too low and that five volts (46 amps/sq.ft.) cause the efficiency of the solution to fall down. The higher voltage apparently causes the amperage to rise entirely out of proportion to that obtained at 2 and 3 volts. The best efficiency is evidently obtained at about 3 or 4 volts.

Theoretical weight	7.51	36.35	5.14
Found weight	5.94	8.55	2.45

In order to determine roughly the variation in thickness of the deposit on a single disc, some pieces from each series were subjected to a strip test. Spots from which the deposit first disappeared were judged to have the thinnest deposit. On this basis, the following observations were made.

In series I. the plate is about the same on the front and the back. It is the thinnest at the center, gradually increasing toward the circumference and is the heaviest on the edges. Series II. shows a heavier plate on the front than on the back, especially near the center. The plate is very heavy on the edge and also on both surfaces near the edge. The heavy sections extend inward about 1/4 of an inch from the edge on the front and also on the back.

In series III. two tests indicate that the back has more plate than the front and one test shows both surfaces to be about the same. It is very evident that the copper has not piled up on the edge, as the edge, or some point on the edge was among the first places to be stripped.

All the above tests indicate a considerable variation in thickness of plate on any one piece. Series I. and II. show the heaviest plate around the circumference. The back shows a surprisingly large amount of plate considering that there are no anodes directly in the rear of the pieces. However, it is reasonable to suppose that curved pieces or caps would not show as much copper on the back as the straight discs used for this test.

This test shows plainly the variation in thickness of deposit from one section of a disc to some other section of the same disc. It should be apparent that stripping any sections of the

plate and determining the weight of the plate, is not going to give an accurate picture of the plate and that considerable variation in results is very likely to occur, depending on the size and location of the sample selected for investigation. Usually the shape of the cap does not permit much choice and the sample must be taken at the most convenient location.

The variation in total plate from one disc to another on the same rack is given below. This figure is given as the percentage variation from the average value which was obtained by adding up the weights of the deposit and dividing by the number of discs. Series I shows a variation of plus 8.4% and minus 7.4%; series II plus 6.0% and minus 6.2% and series III plus 9.0% and minus 7.3%. Evidently the higher efficiency in the bath gave the greater variations in plate from one cap to another.

The following conclusions in regard to uniformity of the deposit are made from test data given above. The inside pieces on the rack average slightly higher than the outside. The top pieces No. 1 have the most plate. Nos. 2, 3, and 4 have slightly less than the top and each one has slightly less than the one above it. A rather pronounced drop off in deposit occurs at Nos. 5 and 6. The bottom piece No. 7, shows an increase and is about the same as Nos. 3 and 4. The inside top pieces have the heaviest deposit and outside numbers 5 and 6 pieces have the least deposit.

The results of these tests are more consistent than those of previous tests which were run on production caps.

A test run several months ago confirms the following points. The top cap receives the most deposit and the three bottom caps receive less than the four top caps. It differs from the present test in that it shows that the outside caps receive more deposit on the average than the inside caps and the bottom cap receives the least deposit of all. The percentage variation in deposit from the average was plus 20% and minus 14%.

One unusual feature about this test is the 46 amperes per sq. ft. obtained at 5 volts. Previous tests, to an average of about 19 amperes per sq. ft. was obtained with this voltage. Outside of the possibility of an error creeping in some place, the only other explanation would be the composition of the solution. The analysis of the present solution was given above while the analysis of the previous solution was:

	Gms/Liter	*Oz/Gal.*	*Normality*
Copper Cyanide	30.	4	.33 Copper
Free Sodium Cyanide	26.3	3.5	.52
Sodium Carbonate		3.4	

The discs used in this test had the disadvantage of having only one point contact, whereas the caps usually have three point contact. The discs had the advantage of presenting a flat surface to the anodes, whereas the caps are usually drawn out, rounded, recessed, etc. It is scarcely logical to draw any conclusions about the uniformity of plate on the caps from the results obtained on the discs but it does seem as if the variations would be about the same in both places.

SUMMARY

In the cyanide copper bath there are five causes for non-uniformity of copper plate: (1) the position of the work on the racks; (2) lack of good contact of the rack with the work; (3) variation in current density with the shape of the work. The primary object of this test was to eliminate items Nos. 2 and 3, as far as practical, and determine the effect of item No. 1; (4) Stratification layers within the solution; (5) Stray currents, if steel tanks are used.

Previous tests showed that variations in contact entered to such a degree that conclusions could not be made with any degree of accuracy. In this test the results of three series, run under different conditions of voltage and amperage were fairly uniform and may be summarized as follows: the top pieces received the most deposit; lower pieces receive smaller amounts of deposit according to their position on the rack, except the bottom piece which is about the same as those in the middle of the rack.

This test shows that the inside pieces have more deposit than the outside pieces but it is questionable if this is always true. With this particular rack and good contact a variation of at least 16% must be expected in the total deposit. Variations in contact in production plating would lessen the degree of accuracy considerably.

Although the above variations from piece to piece appear large, it appears that even greater variations may appear on any one piece. This variation is due to poor distribution of the current density on the surface of the piece.

On account of all the above variations, it is to be expected that variations will occur and that results cannot be checked by determining the weight or thickness of the plate on any one section.

Dr. L. C. Pan in his paper on "Concentrated Copper Cyanide Plating Baths" gave us very valuable information regarding Hot Copper Cyanide Baths. The figures he gave at that time were very nearly correct for practical use and not merely for laboratory tests which my figures proved before.

Free Cyanide g/l By Analysis	*Anode Efficiency*	*Cathode Efficiency*
0.15	43.4	94.2
4.0	66.5	89.9
4.35	67.4	86.3
4.55	68.2	.....
6.9	67.0	71.7
8.05	78.0	86.2
13.45	88.5	80.0
20.5	80.5	58.7
20.95	93.0	62.9
23.2	89.5	57.3
25.05	87.5	53.4
32.6	97.1	41.5
25.05	90.0	26.7
42.25	95.8	19.8

He demonstrated that only a limited amount of cyanide can be used to be efficient and he proved that 13.45 g/l free cyanide is the correct amount and voltage not over 4.5 volts and not more than 18 amperes per sq. ft.

In discussing Dr. Pan's paper, George Kutzen of the Ford Motor Co., Detroit, made the following remarks: "I have not very much to say only that we differ somewhat from Dr. Pan regarding free cyanide. We operate our bath at 8.23, metallic copper or copper cyanide, 11.59 oz. and free cyanide 5.39 which would be equal to almost 74 g/l per liter"; which would be almost six times the amount of cyanide they should have used in order to get good efficient deposit. His reason for high

cyanide content was to prevent the formation of carbonates; but what a price was being paid to prevent this. He also stated that "the use of 30 amps for 28 minutes which amounts to 840 ampere minutes and only obtained 0.0005 of copper, which proves their cathode efficiency was very low."

If cyanide content would have been correct, they should have obtained a deposit of at least 0.0009 of copper. Figure their cathode efficiency at 60% at least. It has been proven that one can obtain 80% of cathode efficiency and still maintain your solution constant without additions of copper cyanide. When I make that statement, I mean that you must add your sodium cyanide every two hours and not every 24 hours as some believe. It can be done very easily if we know what we are plating. Let us assume that we are plating 288 sq. ft. of surface every hour. That would mean that we deposit 0.0005 of copper per sq. ft. We would actually deposit 288 x 10.46 grams per sq. ft. which equals 3012 grams per load or about 104 ounces which is 6½ lbs. of copper per hour. We found that in production about 1½ lbs. of cyanide was consumed for each lb. of copper deposited per hour. This meant an addition of 10 lbs. of cyanide per hour to keep the solution constant.

According to Faraday's Law and in accordance with common sense, this statement would not be true, but in actual production you will find that these figures are very near being accurate.

From the facts and figures outlined in this paper, it is easy to see that all Copper Cyanide tanks should be glass lined or lined with a suitable substance. The lining should be of material that will prevent stratification and stray currents as these two things cause enough trouble to warrant the lining of the tanks for cyanide solution with a lining non-conductive to electricity.

It is very reasonable to see that the cyanide solution changes in composition as it is electrolized. For instance, the composition of the bath is different at the upper level of the solution than it is at the bottom. Please do not ask me to explain this.

Observations on **Electroplating** *in Europe*[1]

WILLIAM BLUM[2]

Read at Bridgeport 1935 Convention

I. INTRODUCTION

IN a brief summary of the observations during a six weeks' trip through England, France, Germany and Holland, it is not practicable to define the exact conditions used in the plating plants or the details of researches. Instead, an effort will be made to give the background of the activities in electrodeposition in these countries and glimpses of the interesting personalities involved in them. The most pleasant and profitable results, and probably the most lasting memories of such a trip, are associated with the large number of persons who devoted their time and thought to making it successful.

Such cooperation was especially necessary in France, where my limited ability to speak the language would otherwise have greatly reduced the value of my visits. In Germany, my knowledge of the language was sufficient to be very helpful, while in Holland, all educated persons speak English. In spite of the generous assistance received on the Continent, the language barrier was still an obstacle to getting very detailed or accurate information. Each of the visits was necessarily short, as about 50 plants and laboratories were visited. A critical study of electroplating processes would require more time and greater familiarity with the foreign languages.

II. SCIENTIFIC MEETINGS

The meetings of the Faraday Society in London furnished a good opportunity to meet men engaged in researches in electrodeposition and related fields in England, France, Germany, Switzerland, Czechoslovakia, Holland, and Sweden. The sym-

[1] Publication approved by the Director of the National Bureau of Standards of the United States Department of Commerce.

[2] Chemist, National Bureau of Standards.

posium included about 25 papers on "The Structure of Metallic Coatings, Films and Surfaces", many of which have been abstracted in the MONTHLY REVIEW of the American Electro-Platers' Society.

These papers described efforts to apply to this problem the most advanced methods of scientific research and illustrated the difficulties of interpreting the results. The papers and discussions showed how little is really known of the internal structure of electrodeposits, and emphasized the effects of small amounts of impurities, such as oxides, on or in the coatings. There need be no fear that the field for scientific study of problems in electrodeposition is exhausted!

The discussions were lively and valuable, though somewhat hampered by the language barriers and by the large number of papers on the program. The social gatherings, including the interruptions for coffee in the mid-morning and for tea in the afternoon, furnished opportunities for those valuable personal contacts that in our meetings are usually made in the lobbies during the sessions. The foreign guests were also invited to the annual dinner of the British Chemical Society; and to the Royal Institution to hear a splendid address by Lord Rutherford on "Neutrons" and to view the exhibits, including much of Faraday's apparatus.

Two meetings of the Electrodepositors' Technical Society were attended. This organization, composed of both chemists and platers, deserves much of the credit for the increased interest in research on electrodeposition in England during the past ten years. Its meetings are very similar to those of the American Electro-Platers' Society, but with a smaller membership. Most of the papers are presented and discussed by chemists, but the platers take a lively interest and do not hesitate to make pertinent remarks.

The meeting in Birmingham was of special interest because it was devoted to specifications and tests for electrodeposits, and covered much the same field that the American Electro-Platers' Society committees have considered during the past year. The

Electrodepositors were very glad to learn of our exposure tests and of the pending American specifications, upon which there was considerable discussion.

The meeting in London was devoted to a paper by E. A. Johnson, on "Tin Deposition in the Refrigeration Industry", in which the experiences of a practical plater were described. The critical but friendly discussion of this paper was a fine illustration of that spirit of cooperation between platers and chemists that is so evident in both the Electrodepositors' and the Electro-Platers' Societies.

III. RESEARCH LABORATORIES

The meeting of the Faraday Society served as a prelude to visits to laboratories, where the work of the various investigators could be observed. During intermissions, the laboratories of Dr. G. P. Thompson and Dr. G. I. Finch at Imperial College in London were visited to view their equipment for electron diffraction studies. At the University of Sheffield the metallurgical and electroplating laboratories were of special interest, because classes for platers have been held there for many years. At Cambridge University, Dr. R. S. Hutton has developed, in the last few years, splendid facilities for metallurgical research; and Dr. U. R. Evans is conducting his exhaustive studies on corrosion. At the National Physical Laboratory, near London, Dr. Cecil Desch is making extensive investigations on the structure and properties of metals; Dr. W. H. J. Vernon is studying the tarnishing of metals and plated coatings in natural and artificial atmospheres; and Dr. Bengough is investigating the corrosion of iron.

At the Aeronautical Research Laboratory at Farnboro, near London, Dr. Sutton and his associates are studying the chemical and electrolytic methods of protecting aluminum and magnesium alloys against corrosion. No plated coatings are especially promising for this purpose.

The visit to the laboratories of the British Non-Ferrous Research Association was especially interesting, because this organization is now attempting to obtain from manufacturers an annual sum corresponding to about $5,000 to be devoted to researches

on electrodeposition. In many respects this project is similar to the cooperation between the American Electro-Platers' Society and the National Bureau of Standards.

The best equipped laboratory in England for research on electrodeposition is at the Woolwich Arsenal, where Dr. D. J. MacNaughtan and his associates have made extended studies on nickel deposition. This and similar work is now being actively continued by Messrs. Hothersall, Gardam, Clark and Hammond, with modern equipment for chemical, physical and metallurgical studies, and for deposition on a relatively large scale.

In Paris, Dr. Charles Marie, Professor of Electrochemistry at the Sorbonne (who is a member of the American Electro-Platers' Society) kindly arranged a luncheon in order to bring together those persons directly interested in electrodeposition. Subsequently his laboratories were visited, and the work of Messrs. Thon, Guerillot, Trombe, and Jacquet (who is now on a fellowship of the Electrochemical Society), was observed. At the Centre d'Information du Nickel, the experiments of Dr. M. Ballay on bright nickel were discussed.

In Berlin, at the Materialprüfungsamt, the experiments of Dr. O. Bauer and Dr. H. Arnt on plated automobile parts were discussed with these investigators. Their specimens were plated in commercial plants, and hence the results were less uniform than those obtainable on laboratory specimens.

At the University of Amsterdam, Dr. A. H. W. Aten is still much interested in electrodeposition, but increased teaching duties have prevented him from devoting much time to research. Of course, many European laboratories that were not visited are engaged in studies on electrodeposition and upon related problems, such as those presented at the meeting of the Faraday Society, which gave ample evidence of a renewed interest in this field.

IV. ELECTROPLATING PLANTS

Most of the plating plants that were visited are connected with the automobile and bicycle industries, which are now relatively busy in all of the above countries. This condition is reflected in the increased activity of the electroplating supply houses,

especially of W. Canning and Company, in Birmingham, and of the Langbein-Pfanhauser Company, in Leipzig, the two largest European firms in this field. I am greatly indebted to Mr. Ernest Canning and to Dr. W. Pfanhauser, not only for showing me through their interesting factories, but also for furnishing me with information regarding the equipment and methods used abroad.

Each of these companies is engaged in the manufacture of a complete line of generators and other plating and polishing equipment, and in related activities. For example, the Canning Company maintains a staff of several chemists under the supervision of their Chief Chemist, Mr. Dobbs, who analyze periodically the solutions used by their customers. The Langbein-Pfanhauser Company manufactures ammeters and voltmeters, and also does a considerable amount of commercial plating, for example of sheet steel and brass. They also maintain a small commercial plant for training platers. Each of these firms has a large export business. They are conducting researches on new or unusual applications of metal coatings, such as chromium plating in barrels, zinc deposition at high current densities, anodizing aluminum, and vaporizing gold and silver onto non-metallic surfaces.

In Birmingham I went through the plating department of Lucas and Company, manufacturers of auto lamps, in company with about forty members of the Electrodepositors' Society. Two full-automatic tanks are used for nickel plating brass lamp-bodies; and two others are used for nickel plating and silver plating the reflectors, with no intermediate buffing. The nickel baths are agitated with air and continuously filtered. The chromium plating is done in semi-automatic circular or elliptical tanks. One unusual sight was the employment of women buffers, in white suits that kept fairly clean because of the very good ventilation. Another novelty was the application of a very thin lacquer film to the polished silver reflectors.

In Paris the large modern plant of the Renault Automobile Company proved very interesting. Most of the plating (except

of bumper bars) is done in full-automatic units. The procedure on steel parts is about as follows:

1. Clean with trichlorethylene, both liquid and vapor.
2. Clean cathodically in a solution of caustic soda and trisodium phosphate.
3. Pickle anodically in sulphuric acid (52°Be). (Anodic pickling is more extensively used in England and on the Continent than in America.)
4. Plate 10 minutes in a copper cyanide bath at 25 amp/ft^2.
5. Plate 30 minutes in an acid copper bath at 30 amp/ft^2.
6. Buff the copper.
7. Again plate 10 minutes in a cyanide copper bath.
8. Plate 30 minutes in a warm nickel bath (agitated with air) at 35 amp/ft^2.
9. Buff the nickel.
10. Plate 2 minutes in a chromium bath at 140 amp/ft^2 at 113° F.

This cycle has been given in some detail because it shows the great care used to produce good deposits, which have a total average thickness of about 0.0015 inch.

Bumper bars are plated with nickel, acid-copper, nickel, and chromium, while radiators are plated with cyanide-copper, acid-copper, nickel, and chromium. Zinc-base die castings are given a "strike" in a copper cyanide bath, and then plated with nickel from a high-sulphate bath.

In the Marchal Lamp Works in Paris, the brass bodies are given a "flash" in a combined cleaning and copper plating bath, dipped in 10 per cent hydrochloric acid, and plated seven minutes in an agitated nickel bath at 120° F. and 45 amp/ft^2, then polished and chromium plated.

At the Repousseau Bumper Works, the bars are made of low carbon steel that is not heat-treated. They are plated for fifteen minutes with nickel at 60 to 90 amp/ft^2 in filtered, agitated baths. After polishing, they are plated with chromium for six minutes at 250 amp/ft^2, which gives an unusually thick deposit.

The Opel Works in Russelsheim, Germany, is now owned and

operated by the General Motors Corporation, with a monthly output of about 10,000 cars and 15,000 bicycles. Mr. H. Baier, who is in charge of their finishing operations, showed me their electroplating plant. The apparatus and methods are modern, though not quite so much automatic equipment is used as in corresponding American plants.

The steel bicycle parts are plated with nickel (with no copper) for about thirty minutes in a full-automatic machine at 90°F and 10 amp/ft^2, which gives a deposit of about 0.0005 inch. They are then plated with chromium for about four minutes. The spokes are plated in still tanks.

The automobile radiator shells are plated with about 0.0006 inch of copper in a cyanide bath, buffed, and plated with about 0.001 inch of nickel in a warm bath at 25 amp/ft^2. After buffing, they are chromium plated for four minutes at about 105°F and 150 amp/ft^2.

Bumper bars are plated with nickel, acid copper and nickel, then buffed and chromium plated. Cast nickel anodes are used, and the pH is about 5.4. A proprietary bright-nickel plating solution has been tried and found fairly satisfactory on brass but not on steel. Chromium plated steel parts are required to withstand a spray of five per cent salt solution at room temperature for 72 hours.

In Sheffield, England, interesting visits were paid to the job plating plant of Bowkers, and to the manufacturing and plating plant of Walker and Halls, at both of which high grade silver plating is done.

Bowkers are mostly engaged in silver plating of flat and hollow ware, including "contract" work that is manufactured in other plants, where it is polished after plating. Nickel and chromium plating are also done, as well as some gold plating. One apparent novelty in the silver plating was the removal of spoons when half the desired thickness of silver was deposited, in order to scratch-brush them before completing the plating. Potassium salts and the carbon bisulphide brightener are used. Carbonates are removed periodically by adding a suspension of barium phosphate.

(The use of this procedure implies that the potassium phosphate thereby formed in the bath is less harmful than the equivalent amount of carbonate.)

Walker and Halls manufacture a full line of sterling and silver plated tableware, as well as glassware and other table equipment. No automatic tanks are used for the silver plating. Each oscillating cathode rod has an ammeter connection, so that the current density (about 4 amp/ft^2) can be kept more nearly uniform. Their experience has shown that the best throwing power is obtained in baths with about 7 oz/gal (U. S. gallon) of potassium carbonate.

Large gold plating tanks are used occasionally, for example for the fittings on the royal railway car.

From this necessarily incomplete survey of European plating practice, it appears that the processes in large plants do not differ greatly from American practice. Automatic equipment is now being installed which is quite similar in its major features to that used here. Perhaps the most evident differences are the almost universal practice of anodically pickling steel, and the use of air agitation (with good filtration of the solution), in the nickel plating baths, which permits their operation at relatively high temperatures and current densities. Whether deposits so produced are equal in quality to those from unagitated solutions could be determined only by careful comparisons. Such conditions at least warrant consideration in any study of plating.

Cadmium plating is more extensively used than zinc plating in the automobile plants visited, though concern was expressed regarding the recent increase in the price of cadmium.

V. MISCELLANEOUS VISITS

Many other places visited are of some interest to electroplaters. For example, many of the printing plants, especially those for printing currency, are using electrolytic plates with a chromium plated surface, although chromium plating is not being used extensively on electrotypes. Much rotogravure printing is done. Most of the rolls are plated by the Ballard

process, in which a relatively thin copper layer is deposited on the nickel plated cylinder. Sometimes the copper is polished with agate during deposition. The copper layer is removed mechanically after one printing operation. In a few plants the rotogravure cylinders are chromium plated.

The plant of the Mond Nickel Company near Swansea was of special interest because this is the only place where nickel is refined by the carbonyl process. The resulting nickel is in the form of shot and is very pure and almost free from cobalt, which is present in small amounts in electrolytic nickel. The manufacture of nickel salts is carried on there on an extensive scale.

The platinum metals refinery of the Mond Nickel Company, at Acton, near London, illustrated the methods of handling on a relatively large scale the residues of platinum metals that are obtained from both the carbonyl and electrolytic refining of nickel. At this plant, Messrs. Atkinson and Raper have made valuable researches on the plating of palladium and rhodium, the results of which have been published.

The Reichsausschuss für Lieferbedingungen (a Government Specifications Board) in Berlin has prepared specifications for silver plated flatware and also for silver plated porcelain. A considerable amount of the latter is now made. In each case, the use of certain terms is confined to articles that meet the thickness specifications. The officials were much interested in the pending American specifications for plating on steel.

VI. ACKNOWLEDGMENTS

The pleasure and value of the trip was greatly increased by the courtesies received in all the countries visited. These included not only arrangements for visits through plants and laboratories, but also incidental sightseeing and invitations to homes. These social contacts supplemented the acquisition of technical information with that spirit of friendship which is so much needed in the world today. This cordial association of scientists and technicians of different lands is an inspiring example of international fellowship.

How Do We Learn?

By EDWARD H. TINGLEY
Secretary
National Association of Foremen

WHAT is intelligence? The simplest definition is, "The ability to learn." It is this ability to learn that distinguishes the man from the ape, the dog from the rabbit. The real test of our intelligence is the ability to use our knowledge to solve new problems—to meet new situations.

But how do people become intelligent? How do we learn? What is this process called "learning"?

There are two distinct ways in which we can learn:

(1) *We can dig it out for ourselves*, or
(2) *We can learn from others.*

The first method—digging it out for ourselves—means learning from our own experiences. And we do learn a lot that way. As a boy we learned that the stove was hot by burning our fingers on it. In the shop, we learn by trial and error. Many different methods are used and many are failures until finally we find the right one that works. In making the incandescent film for the electric light bulb, Edison tried over 50 different materials. The trial and error method is responsible for many new inventions and improvements, but is being superseded today by scientific analysis based on a study of past experience. The larger corporations have an experimental engineering department with engineers continually studying new methods and improvements in the product.

Henry Ford tells how he learned by experience when he was young:

> "When I was a boy I went from shop to shop, machine shops, boat shops, and others, in quest of knowledge. In some places I got into trouble. There were just about as many places from which I was kicked out as there were places in which I was welcomed.

"These shops were my school. I conducted my investigations and got all the knowledge I could about what had been achieved mechanically by traveling around. It took a lot of time. In my youth, in the 19th century, it was much the same as in the olden times. The apprentice had to travel through many cities and states, to learn the state of his art."

Today many companies in America are developing excellent apprentice courses, giving young men training in many branches and showing them all the tricks of modern processes, so that he can learn much faster than the apprentice did sixty years ago when he had to "dig it out for himself". Nobody cared if he learned anything or not. Now the boys have class room instruction in related mathematics and science to make them understand better the practical operations.

Even today some men insist on digging it out themselves, especially when they set out to do a new kind of job—to design a machine, to improve a process or write a thesis. Working alone they will spend a lot of time and money and get nowhere. The first thing they ought to do is to discover all they can about what has already been accomplished by others, who have worked on the same problem. If they do not know what has been done before, their new ideas may be found to be old ones long ago discarded. At the Dearborn Museum, Henry Ford has a collection of various mechanical devices which show the student all the way back, the development of every principal series of mechanical inventions. To improve a product or process, one should begin where the other fellow left off.

Each of us has a characteristic way of learning. Some of us learn more readily through the ears, some through the eyes, some through the muscles, some through a combination of two or three of the senses and some through the association of ideas. There are people who can remember statements which they hear but recall little that they read. Others must slowly read a page to really learn it. The mechanic is the fellow who wants to get the feel of it in his hands, to go through the motions, to learn by doing. All of us know that if we can use our muscles to write

a person's name, after we hear it, and then look at it intently for a few moments, we will more easily remember that name. Most every thing we learn is through a combination of senses: sight, touch, smell, hearing, taste—but we all have our own peculiar methods of learning. We should try to translate each new experience into the field in which we are the most successful in learning. If we are poor at remembering names—and if writing the name will help us, we should have a pencil and card handy and write the name at the earliest opportunity after we have been introduced to the person. I know of some public speakers who must go into a closed room and say out loud their speech—as this helps them remember it better than just reading it over.

Association of ideas is the most important function in memory. When we associate the new idea with something we already know—we add to our knowledge. We develop connections that make recall easy. We do something about the new idea. We place it alongside ideas which we can recall, so it becomes a definite part of our learning. Good teachers usually review the subject briefly before bringing out the new idea and thus tie it in to our previous knowledge.

LEARNING FROM OTHERS

There are three ways we can learn from others:

(1) *By observation,*
(2) *By conversation,*
(3) *By reading.*

Even if we had the desire to work out everything for ourselves, we still would learn a lot from others. We are tremendously affected by our environment, by those we associate with, by public opinion, by custom or habit or by parents.

As children we were imitators—as we grow up we still are imitators. We continue to do things the same way they have always been done—it's the line of least resistance. You have heard of Mr. Kettering's statement, "The greatest endurance

contest is to get a new idea into a factory". People resist the new.

A person who has the ability to create, discover or procure new ideas is a valuable asset to the company he works for. Progress is made possible by constant improvement in manufacturing methods, design of products, sales policies and the personnel of the organization. Before you can improve anything, you must in some way, get a new idea about the thing you want to improve.

It would be great if we could write an order for a number of new ideas according to specification at so many dollars per. Experience has taught us, however, that they are not to be had so easily.

OBSERVATION

Keen observation is a definite method of getting new ideas and each normal person has some capacity for observation. This capacity varies in different people, some are blessed with an unusual amount of natural ability, while others have to develop it.

Have you ever analyzed a full day's activities to see just how much you have accomplished, how many new ideas you have received during the day and what method was used to get them? Chances are you haven't but try it sometimes and you will be surprised. Many new ideas are discovered by Observation.

Too many foremen and executives are missing great opportunities for new ideas by staying in the main aisles when they make the rounds of the plant. Always be on the alert for new things. When you look at things see all there is to see, be analytical and ask how, what, why and when. You will also find that this method will make commonplace things very interesting. I often say there are two ways of observing. One way might be compared with the camera, you get just a flash or an image of the object in sight and nothing is done about it. The other way is observing with the eye of the mind. This

is the kind of seeing that stimulates imagination and finally creates or discovers new ideas.

Keen observation is necessary in successful leadership. If you have it, make it work for you. If you do not have it, start today and acquire it because it can be developed.

Begin by observing what is about you!

CONVERSATION

Real conversation is an art. It is not practiced as much these modern days as when grand-dad had plenty of time and nowhere to go. Conversation should be an exchange of ideas—a sharpening of our thoughts against those of another person; a give and take proposition, allowing both parties to state their opinions or experience. Occasionally we are present when the conversation becomes a monologue—all one sided.

A conversation is not a monologue. There is just as much listening in every conversation as there is talking. Most people would rather air their own views than listen to yours. Too much talk at one time tends to bore the other party, to make him chafe with restlessness until he can find an opportunity to say what he wants to say.

One of the quickest ways to learn is to listen. If anyone develops the faculty of listening, and listens to worth-while things, he certainly can soon accumulate an immense lot of facts. Bascom Slemp, Secretary to former President Coolidge, writes about the President's mind:

> "He knows that by intense mental application there is every probability that he can always secure the right solution to any problem. He begins an important inquiry with all the zest of his spirit. He takes counsel. He seeks advice. His methods are those of a trained research worker. He sends for wise and informed men, and for books and documents—but especially for men. *He loves to listen.*"

Benjamin Franklin, in his list of virtues, strongly recommended humility in conversation. He avoided all such words as "cer-

tainly", "positively", "undoubtedly", "I am sure", etc. He rather asked for information, by agreeing with the ideas of the other person and then submitting his ideas in a tactful way. The fellow who is absolutely sure about everything gives the impression of a self-centered individual, interested in his own ideas and having little patience for the ideas of others. Such people never learn anything from a conversation.

Even though the subject about which you converse is a trivial one, you should make your conversation purposeful. If your purpose is to improve your relations with the man or men with whom you are conversing, you should show that you are a person of intelligence and sound viewpoints. Mere idle prattle naturally is not enough to impress him. You must know something—have greater knowledge than the other man—provided you are not vain about it. If he knows more about some specialty than you do, your part of the conversation should be tactful questions—leading him to give you the information you desire. Many younger executives use this method in testing their plans with the advice of their superior officers. If we talk to people who know more than we do, we are sure to learn something.

READING

Reading is the principal way for most people to learn. The opportunities to observe others in a great variety of situations will be limited by our lack of time and money to travel. Our chances to listen to or converse with, the great people of the world, will also be greatly restricted. But we can get the results of their thinking and observation and their experience and work, by reading their books. And how fortunate it is for us, that so many people who have done such outstanding jobs in the world and lived such busy lives, have taken time enough to write.

A good book is the essence of a man's thinking. Into a book he puts his finest thoughts—he works them over and over and finally gives us his real philosophy of life. He is careful of what he says and concentrates years of experience in a few sentences. He does not ramble—as he might in a conversation.

How many of us would spend a lot of money and time if we could but have a good conversation with Henry Ford, Walter Chrysler, Glenn Frank, John D. Rockefeller, Jr., and many

other notable persons. Well we can, if we will read what they have written in magazine articles and books. And the best part of reading is that you can choose any hour of the day or night to have your conversation with such people. You can repeat the conversation as often as you wish and no one is offended. We are most thankful to the printer and the art of printing that has made this great pleasure and the advancement of the race, possible.

Some people enjoy reading, others find it difficult. People differ greatly in the efficiency with which they read. Many of us have formed reading habits which greatly hamper us in trying to acquire information. We do not know how to read rapidly enough. Too much time is consumed in getting through a long article or book, so we become discouraged and stop before we reach the meat of the argument. It is possible to improve our ability to read more rapidly, just as it is possible to improve ourselves in any other direction. We should learn the rules for rapid reading, apply them, and as a result be able to cover much more printed material in a shorter time and thus add greatly to our store of knowledge.

Much reading is ineffective because the reader reads words rather than considers ideas. This is passive reading rather than active reading. Words pass through the brain without leaving any lasting impression. Active reading means that as you read, you think. You bring all your past experience to bear upon the passage being read. You increase your information. You tie up the new material to the old which has been assimilated and you check the ideas of the author against your own. Such reading is most effective and is the best way to improve your intellect and education.

Since our ability to interest others depends so much on what we say and how we say it, the art of reading cannot be neglected. Not only do we acquire information about events or materials we could never experience, but we increase our vocabulary, improve our own English style and are stimulated to think along new lines. And all this can be had by giving ten to twenty minutes a day to thoughtful, purposeful reading.

The Abstract Section

PATRICK J. SHEEHAN, *Chairman, Program and Educational Committee*

Improvement in the Quality of Tin-Plate by Superimposed Electrodeposition of Tin. A. W. HOTHERSALL and W. N. BRADSHAW, *J. Soc. Chem. Ind.* **54,** 320, (1935)—It was found that electrodeposition of tin from alkaline stannate solutions upon commercial tin-plate (such as is used in tin cans), greatly reduced the porosity of the coatings. On tin-plate with a hot-dipped coating of about 0.00009 in., (1.5 lb. tin per "base box"), it required the deposition of about 0.0005 in. (8 lb. per "base box") of tin to practically eliminate the porosity; although the deposition of as little as 0.000015 in. of tin (0.25 lb. per base box) produced a decided reduction in porosity. Reduction in porosity was also obtained by depositing tin on tin-plate that had been previously bent. The process may therefore be applied advantageously to articles fabricated from tin-plate. W. BLUM.

The Influence of Certain Factors on Electrolytic Deposits. P. VANDROZ, *Galvano,* Sept. 1935, p. 22 and Oct. 1935, p. 20—In a projected study of the effect of current density, pH, temperature, bath composition, and agitation upon nickel deposits, the author first considers the influence of current density, particularly upon the resistance to corrosion.

The deposits studied are made in a filtered bath at 45°C, pH 5.2 to 5.5, with air agitation. The bath composition is not given, but presumably consists of a solution of nickel sulphate and ammonium sulphate only.

In a series of nicrographs of deposits made at current densities ranging from 0.5 amp/dm^2 (4.6 amp/sq. ft.) to 9.0 amp/dm^2 (84 amp/sq. ft.), the author finds the deposits to consist of aggregates of sphero-crystals. At current densities up to about 2.5 amp/dm^2 (23 amp/sq. ft.), these are normally arranged in layers parallel to the plating surface. At higher currents, a fibrous structure develops, with growth perpendicular to the plating surface.

A graph shows that the maximum resistance to corrosion, as shown by the effects of salt spray in approximately 175 hours upon coatings with a thickness of about 0.014 mm (0.00055 in.), is obtained at current densities of 1 to 2 amp/dm^2 (9.3 to 18.6 amp/sq. ft.). C. T. THOMAS.

Study of the Throwing Power of Electrolytic Baths, ALBERT PORTEVIN and MICHEL CYMBOLISTE, *Compt. rend.* **201,** 819 (1935)—In this preliminary note, the authors describe briefly the results obtained with a new device for measuring throwing power. This consists of two concentric coils of

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fine wire, held between two insulating plates at the ends. The two coils are connected to form the cathode, which can be immersed in a large or small plating bath. The weight of deposit on each coil is determined, and the throwing power is expressed as the ratio (in percent) of the weight on the inner coil to that on the outer coil. A few typical results are given for baths of tin, zinc, cadmium, copper, and nickel. W. BLUM

Examination of Electro Deposited Nickel Coatings by X-Ray Diffraction, W. A. WOOD, *Phil. Mag.* **20,** 964 (1935) - Supplemental Number)—The nickel deposits were applied to copper wire or copper plates from (1) a nickel sulphate-sodium chloride-boric acid bath (which produces relatively soft deposits) and (2) a nickel ammonium sulphate bath, (which produces harder deposits). No addition agents or brighteners were used. In each bath brighter deposits were produced at low than at high current densities. The brightness was found to be associated with the degree of selective orientation of the metal grains (that is, the extent to which, for example, the grains were parallel). The hardness was associated with the degree of diffusion of the X-ray spectra. The grain size was estimated from the broadening of the spectral lines. W. BLUM.

Electro-Deposition of Chromium for Wear Resistance, JOHN KRONBEIN (preprint). To appear in *J. Electro-depositors Tech. Soc.*, Vol. **11** (1935-36).—For plating steel gages, dies, molds, etc., the author recommends a chromium bath containing 250 g/l (33 oz/gal) of chromic acid and 2.4 g/l (0.32 oz/gal) of sulphuric acid, at 37 to 41°C (98 to 105°F) and current densities up to 200 amp/ft. At this c. d. it requires 2.5 hours to deposit 0.001 inch of chromium. It is recommended that wherever feasible, the steel be hardened before chromium plating. W. BLUM.

Electrodeposition of Zinc and Cadmium on Aluminum and Aluminum Alloys, B. K. BRAUND and H. SUTTON (preprint). To appear in *Jour. Electrodepositors Tech. Soc.* Vol. **11,** 1935-36.— Results obtained in an intermittent sea-water spray test showed that zinc and cadmium coatings on aluminum and its alloys are at least as effective in protecting the base metal against corrosion as are similar deposits on iron and steel. The protection of aluminum by zinc deposits is about equal to that furnished by anodic oxide coatings to which grease has been applied.

The most effective method for cleaning the aluminum surface prior to plating was to dip it in a solution of caustic soda containing a small amount of sodium zincate, obtained by dissolving about 1 g/l (0.13 oz/gal) of zinc in a 7 percent solution of sodium hydroxide. A trace of tin (as stannate) in the alkaline was also found advantageous. Some zinc is deposited on the alloys by immersion and apparently improves the subsequent deposition of zinc on the surface. Satisfactory deposits were obtained from zinc sulphate, zinc chloride, and zinc cyanide baths.

In an appendix, experiments are reported on the throwing power of a zinc sulphate bath. Tests were made in (1) a Haring-Blum throwing power cell and (2) in a cell with both cathodes on the same side of the anode, as recommended by Field (without, however, the partition used by Field). Tests were also made with these two electrode arrangements suspended in a large plating tank. It was found that with arrangement (2) in the box, the near cathode shielded the far cathode, so that the primary current ratio was not equal to the distance ratio, as it is in arrangement (1). In either case, when suspended in a large bath, the current ratios were quite different from the distance ratios.

W. BLUM.

Closure of Pores in Tinplate by Electrodeposition by A. W. HOTHERSALL and W. N. BRADSHAW, *Metal Progress*, Vol. **29**, No. 1, page 39, Jan. 1936 — Due to the fact that hot dipped tin is rather porous, a tin plate over the dipped tin is being used to remedy this shortcoming. An alkaline bath having little free alkali is used. The temperature of the bath is 70-75°C, current density 25 amp. per square foot. These conditions give a thickness of tin equal to .25 lb. per base box in about 80 seconds. The dipped tin is cleaned by boiling in a 1% solution of water glass for five minutes. The average porosity of hot dipped coatings of equal coating thickness is 10 to 20 times that of the composite coatings; also the pores in composite coatings are smaller than the pores in the hot dipped coatings. This process is also being sued for plating over hot dipped articles that have already been fabricated.

WILLIAM GEISMAN

Recent Developments in Electroplating by M. de KAY THOMPSON, *Metal Cleaning & Finishing*, January 1936—Research work in chromium plating has aided in bringing the process under better control. There is a possibility that the throwing power may be materially improved.

Greatest activity in nickel plating has been centered on the type of bath best suited for direct plating on zinc. Bright nickel baths are increasingly popular.

Numerous additional agents were investigated in regard to cadmium deposition.

Zinc has supplanted cadmium to some extent. Various additional agents make possible the securing of bright, dense deposits.

It has frequently been suggested that it would be desirable to replace the poisonous silver cyanide bath. Good deposits can be secured from silver iodide dissolved in sodium iodide, with tartaric or citric acid. This bath is in commercial use.

E. T. SHEEHAN.

Application of Copper and Brass Finishes by CARTER S. COLE, *Metal Cleaning & Finishing*, January 1936—In keeping with the trend toward metallic finishes, copper and its alloys have found ever increasing decorative

uses. The familiar antique, or oxidized finishes are apparently finding new favor. Chromium directly on copper and brass continues in popularity. In particular, the architectural field has availed itself of the colorful possibilities with these finishes. E. T. SHEEHAN.

METAL AND ALLOYS ABSTRACTS

1. Present State of Nickel Plating in France, BALLAY. *Metaux et Machines,* Vol. **19,** June 1935, pp. 201-204 — Recent developments have permitted increasing thicknesses up to 1 mm. Chromium plating has contributed to improvement of nickel plating, as chromium is always plated over nickel undercoat. Nickel plating is being used more and more for worn parts. Modern nickel plating practice is as follows: Parts are solvent degreased, cleaned electrolytically with slightly alkaline salts as phosphates and silicates, then treated with acid before placing in nickel bath. Nickel baths used are simple, consisting of nickel sulphate, a chloride to promote anode corrosion and a buffer to prevent rapid changes in acidity. pH is carefully controlled, low pH gives blown coatings, high pH gives brittle coatings. Hot baths are in general use. Baths with colloidal matter give bright, but generally brittle deposits. Copper undercoats are being discarded. French Railway companies specify for ordinary nickel plating a minimum thickness of 0.01 mm., or .02 mm. for quality steel parts. For copper alloys thickness is from .005 mm. to .02 mm. according to uses.

PHIL J. RITZENTHALER

2. Electrodeposition of Nickel from Chloride Solutions. FEDTIEFF & KINKULSKY. *Zeitshrift fur anorganishe und allgemeine chemie,* Vol. **224,** Oct. 18, 1935 pp. 337-50 — For most efficient deposition of nickel from chloride solutions, the pH should be 6.8 - 6.2 at a temperature of 70 - 80°C: 40 grams nickel per liter minimum, current density between 4.5 - 6 amps./dec.^{2} (45-60 amps./sq. ft.). Electrolysis of $NiCl_2$ is said to avoid sulphur contamination and requires less power. This process can be applied to electrowinning of nickel ores. Curves showing solubilities of nickel chloride, current efficiency vs. current density, etc. are given. PHIL J. RITZENTHALER.

3. Defective Silver Deposits. RAUB & BIHLMAIER. *Mittelungen des Forschunginstitutes und Probierants fur Edelmetalle,* Vol. **9,** July 1935, pp. 29-35—An exhaustive investigation of certain defects in silver plating which cannot be laid to metal plated preparation or to bath itself disclosed that certain such defects occur on articles loaded with cements (as knife handles, etc.), the loading cements consisting of resins, asphalt, oils and brick dust. Resins and oils partly dissolve in the alkaline baths and streaks are produced which are often poorly adherent. This effect increased with increase in free cyanide content and an increase in current density. Increase in temperature seemed beneficial. Very small amounts of loading agents spoil bath and are difficult to remove. Another defect is colored deposits due to silver sulphide whose presence can be detected by turbidity of bath. Chemical analysis always reveals Ag_2S in deposit. PHIL J. RITZENTHALER

Newark's Annual Meeting

Newark Branch A.E.S. will hold its Annual Banquet and Educational Session at the Hotel Douglas, 20 Hill Street, Newark, N. J., Saturday, April 18, 1936.

The educational program arranged by Mr. Nelson Sievering will be interesting. The speakers will be as follows:

GEORGE HOGABOOM — OLIVER SIZELOVE

DR. YOUNG — AUSTIN FLETCHER

The banquet committee has arranged for an evening of entertainment with free Bingo Games for prizes and dancing to the tune of a high-class orchestra. The price for banquet tickets is $2.75 each, including Federal Tax.

Horace Smith, *Chairman* — George Wagner, *Program*

Nelson Sievering, *Educational* — Jack Holland, *Publicity*

Oliver Sizelove, William Torrance, George Reuter, Tom Haddow, *Entertainment*

Nelson Sievering, John Kotches, George Klink, *Tickets*

The May issue will contain the following papers recently received:

I. *A Critical Study of Bright Nickel.* By Dr. L. E. STOUT, of Washington University, St. Louis.

II. *A Rapid Method of Determining Boric Acid in Nickel Plating Solutions*, by M. H. LONGFIELD. Read at Chicago Branch Annual Meeting.

Branch Exhibits

The Metal Industry Cup will be presented again this year to the branch presenting the Best Exhibit at the Cleveland Convention.

Business and Social News

BRANCH NEWS

Educational Activities

AMERICAN ELECTRO-PLATERS' SOCIETY

BALTIMORE-WASHINGTON BRANCH

At our regular meeting on Saturday night, we were very much surprised to receive eight (8) applications for membership from the following:

Cedric Arthur Vincent-Daviss, E.I. du Pont de Nemours & Co., Inc., R&H Chemicals Dept., Wilmington, Del.; Gilman Parater, 1205 C St. N. E., Washington, D. C.; Harris M. Lyon, 2250 Minn sota Ave. S. E., Washington, D.C.; Samuel R. Warnock, 258 Kentucky Ave. S. E., Washington, D. C.; Emory L. Plate, 4601 Leeds Ave., Baltimore, Md.; Roland S. Gregg, 5600 Wexford Road, Baltimore, Md.; Mathew J. Kraft, 511 Clay St., Baltimore, Md.; Paul J. Dean, 20 T St. N. E., Washington, D. C.

After our regular business session, we heard a very instructive talk by Mr. J. J. Basch of the Oakite Products Inc., on the subject of *Films and Their Significance in Cleaning Before Plating*, after which we had refreshments and spent a very pleasant evening.

We had twenty-four (24) members present, which is a good attendance for our branch. It shows that we are not only gaining in membership, but our attendance is increasing, and the branch is making "real progress."

IRVIN H. HAHN, *Sec.*

CLEVELAND BRANCH

The regular monthly meeting of The Cleveland Branch of The American Electro-Platers' Society was held at Hotel Carter, Saturday, March 7, 1936.

The meeting was called to order by our president, Mr. W. D. Scott, at 8:15 p. m.

The minutes of the previous meeting were approved as read.

An application for membership was made by Mr. Frank Toriden of 6717 Bonna Avenue, for active membership. At the present he is employed by The National Telephone & Supply Company, Woodland Avenue plant.

The application of Mr. Michael Ruhin for active membership was voted on and he was elected. The secretary was ordered to notify him of his election.

Correspondence was ordered filed.

Motion was made to adjourn to allow the convention committee to take over the meeting at this point.

W. E. O'BERG, *Sec.-Treas.*

ROCHESTER BRANCH

The Rochester Branch held its regular monthly meeting on Friday night, February 21, 1936. Meeting was called to order by Pres. Kohlmeier who immediately introduced the speaker of the evening, Mr. Frederick Bruening, of the Oakite Products Co. He presented a paper entitled "Films and Their Significance in Cleaning Before Plating," written by Mr. Carl Johnson, Technical Director for the Oakite Products Co. The paper had to deal with all the different types of films encountered in cleaning before plating, stressing in particular the minute films which cause waterbreaks. The paper was very well written and presented, and after the reading and asking of numerous questions, it was voted a very instructive evening by all those present.

and Mr. Bruening was given a rising vote of thanks.

After the reading of the paper the regular business meeting was then called to order. The minutes of previous meeting were read and approved. Communications were read, no comments. The following names were brought up for suspension: Mr. Druery Harper, Mr. Ralph Hutchings and Mr. B. G. McManus, and ordered suspended. The bowling committee, headed by Clarence Reama then reported everything ready for a rip-roaring time on Saturday the 22nd.

The following men were then elected as members: Mr. Ray Berghold, Mr. Henry Norgren and Mr. Frederick Bruening. After a little more discussion on various topics the meeting was adjourned.

JUDSON R. ELSTER, *Sec.*

PHILADELPHIA BRANCH

The Philadelphia Branch held its regular monthly meeting on March 20th, 1936, at the Harrison Laboratory, U. of P., President Al. Hirsch presiding.

Dr. Wick of the Bureau of Standards and the Philadelphia Navy Yard was the guest speaker of the evening and gave a very comprehensive talk on what he saw on his visit to England, Germany, and France. Some very interesting facts about the different methods used in plating in these countries as compared with the methods used here were discussed.

This talk was so interesting that the Question Box had to be held over for another meeting and Dr. Wick was given a rising vote of thanks for his fine talk.

Mr. J. Green of the Speakman Co., Wilmington, Del., had quite an exhibit of chrome plated, on bright nickel plumbers supplies, the remarkable fact about this exhibit, was the bright nickel was plated in a nickel bath without the use of any addition agents called nickel brighteners; the bath was made up of nickel salts and boric acid to a pH of 6. This display was very interesting to all.

The following applications received at the Feb. meeting were elected to membership:—

Daniel Miller Specht, of the Federal Prison Industries, Inc.; Joseph Frank Moore, of the U. S. Arsenal, Frankford, and Edward W. Lafferty, of the G. S. Blakeslee Co.

Mr. Reynolds of the Spring meeting committee reported that this meeting would be held at the Hamilton Watch Co., Lancaster, Pa., on Friday night, April 17th, instead of at the Harrison Laboratory, U. of P. There will be plenty of cars available to take all Philadelphia members to Lancaster; due notice of where to meet these cars will be given in the Quaker City Platers' Reminder, also notices will be sent to members and other platers adjacent to the city of Lancaster.

The next meeting will be held the third Friday of APRIL at the Hamilton Watch Co., Lancaster. Be sure to make your reservations for space in cars as soon as you receive notice of time and place to meet. Address your secretary, George Gehling, 5001 Tulip St., Philadelphia, Pa.

GEORGE GEHLING, *Sec.*

DETROIT BRANCH

A regular monthly meeting of the American Electro-Platers' Society, Detroit Branch, was held on Friday evening, March 6th, 1936, at the Hotel Statler, at 8:00 P. M., W. W. McCord, President, presiding.

There were 100 or more persons attending this meeting. It was indeed gratifying to see such a turn-out.

The minutes of the last meeting were read and approved. The following were elected to membership:

Jos. H. Moneweck, 660 Hazelwood Ave., Detroit, Active Member; Eric G. Sampson, Jr., Yale & Towne Mfg. Co., Detroit, Active Member; Roy A. Johnson, Belke Mfg. Co., 1627 West Fort, Associate Member.

There was one application for membership—Mr. Wm. R. Shields, 4310 Buckingham Ave., Detroit, as an associate member. This application was referred to the Board of Managers for report at our next meeting.

A letter was read from the Milwaukee Branch announcing their meeting, March 21st. The letter was ordered placed on file.

We had with us at this meeting Dr. W. Blum of the Bureau of Standards, Washington, D. C., who gave us quite a talk and the results of the exposure tests which have been carried on during the last three years in New York, Pittsburgh, Washington, Miami, and State College. It would seem by the reports and the specimens and the action of corrosion on same that straight nickel if put on properly and the thickness being at least .0001 was more beneficial than either the copper and nickel or nickel, copper and nickle. The tests also bear out that the straight nickel without the chromium has a better resistance to the weather than with chromium. It is gratifying to know that we are benefiting by these tests and that we will be doing a better grade of electro plating in the future. Dr. Blum also gave a talk on his foreign observations while he was abroad. It was very interesting indeed. It is needless for me to go further into it as I have no written paper from Dr. Blum but this will be published in practically every periodical in the trade; suffice it to say that those present at this meeting gave Dr. Blum a hearty applause for the evening.

The meeting adjourned at 11:00 P. M. T. C. EICHSTAEDT, *Sec.*

HARTFORD BRANCH

The Hartford, Connecticut Branch of the A.E.S. held its regular monthly meeting on Monday evening, March 9, at the State Trade School in Hartford, Conn.

The meeting was called to order at 8.30 P. M. with Pres. St. Pierre in the chair. Minutes of the previous meeting were read and accepted. No communications or bills were presented. No new business was brought up.

We had for the evening, two very capable men, who gave some fine entertainment to the twenty-four members present.

Mr. W. H. Stoddard gave an hour's entertainment with magic tricks and sleight of hand. "Bill" sure does know his stuff. President St. Pierre is still wondering how the cards got out of his coat pocket.

Mr. R. L. Leather, Pres. of the Lea Mfg. Co. of Waterbury gave another hour of fine entertainment in the showing of moving pictures of some of the past conventions and banquets.

Both men were given a rising vote of thanks for the fine entertainment of the evening.

The meeting adjourned at 10.30 P. M. V. E. GRANT, *Sec.*

BINGHAMTON-ELMIRA BRANCH

The Binghamton-Elmira Branch held its regular monthly meeting March 2nd, 1936, at the Y. M. C. A., Binghamton, N. Y.

W. J. Schneider of E. I. Du Pont de Nemours & Company, Inc., The R & H Chemicals Department, had planned on giving us a talk on Brass Plating of

High Zinc Base Metals and Die Castings, but due to sickness "Cyanide Bill" was unable to be with us. However we were very fortunate in being able to get Mr. Bert Daw of La Salle Co., who happened to be in this territory, to give us a talk. Mr. Daw told us of some of his experiences and troubles he encountered in his long career. He opened his talk by offering a cigar or a bar of candy to anyone who could solve the problems he met up with. We all found we had something to learn as he departed with both cigar and candy. All in all the talk was both interesting and instructive, and was enjoyed by all.

Mr. Fletcher then asked if anyone could inform him how to maintain a constant metal content in his nickel barrel without the addition of nickel salts. Everyone agreed that a high chloride content would assist him considerably. Mr. Merritt of the I. B. M. Inc., stated that by working on this theory he has been able to run his barrel continuously for over a year without the addition of nickel salts.

Jack Harnett gave a short talk, stressing the necessity of knowing the proper thickness of different platings for different conditions. He read extracts from the REVIEW to back up his statements.

Our next monthly meeting will be April 6, 1936.

LARRY MEYER, *Sec.-Treas.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held March 14, at the Atlantic Hotel, President F. Herbst presiding and all other officers present.

Mr. F. Whalen and Mr. W. Radunz were elected to active membership. An application from Mr. S. J. Borta was read and a committee appointed on same.

Mr. O. E. Servis the librarian found the ollowing questions in the question box.

No. 1. *How can stainless steel be silver plated?*

Answer. Clean in a high caustic solution, with reverse current, rinse and run in a strong cyanide solution with reverse current, rinse then run in a steel strike high in cyanide, then in your regular silver strike, then silver plate.

No. 2. *What is the method for striping lead from Turnplate?*

Answer. High caustic solution with reverse current.

No. 3 *What will make a brass solution plate more of a golden yellow color?*

Answer. Many suggestions offered but thought that after brass plating if

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bright dipped, then just one dip in liver of sulphur then lacquered that this would answer for this color.

No. 4. *What is a good brightener for cadmium, also a bright dip for cadmium plated parts?*

Answer. Glue or Postum. Parts can be bright dipped with a weal solution of Nitric acid, or a weak solution of Chrome and Sulphuric acids.

No. 5. *What is the best way to filter chrome solution?*

Answer. Kill the sulphate, stir, let settle, and drain off the liquid, throw away the sludge.

No. 6. *What is a brightener for a zinc cyanide solution?*

Answer. It was thought that mercury oxidide would do for this purpose.

No. 7. *Which is the best plate to resist corrosion, Zinc or Cadmium?*

Answer. Depends on where it is going if in an industrial damp climate, Zinc; if along the sea coast cadmium would be best.

No. 8. *Why is it detrimental to plate articles that come in contact with food, with cadmium or zinc?*

Answer. Articles that come in contact with food that are cadmium or zinc plated will cause a person to become very sick, also these articles will not pass the pure food laws.

J. W. HANLON, *Sec.*

ROCHESTER BRANCH

On Sat. night, Feb. 22nd, 1936, the Rochester Branch held its annual Bowling Party which was verily a whooping success. There was a very good turnout for this event.

The regular monthly meeting was held at the Seneca Hotel on Friday night, March 20th. Meeting called to order by President Kohlmeier. Minutes of the previous meeting were read and approved as read. Communications were read. No comments. The chairman of the Bowling Committee then made his report and the committee was given a rising vote of thanks for a very successful party and was then dismissed. Mr. Christ Lombardo, whose application was received at the last meeting was elected an active member. The following members were suspended because of unpaid dues:

Harry Puffer, Wm. G. Price, R. E. Pettit, Ed. F. Moulder, and Leeman Leighton.

A committee headed by Chas. Hehr was appointed by the chair to arrange for a party for our next meeting on April 24. Others on the committee are Dan Kennedy, John Honacher and J. J. Desmond. As there was no further business the meeting was adjourned.

JUDSON R. ELSTER, *Sec.*

BOSTON BRANCH

Boston Branch met Thursday the 19th at the Hotel Manger, North Station, Boston, with President Wood in the chair.

Minutes of the previous meeting were read and approved, bills and communications read and placed on file.

Chairman Wood made a report on the banquet held at the Hotel Lenox, Feb. 29th. He reported that it was the best time the Branch has had in a long time and everybody had a good time. A vote of thanks was voted the committee for the fine work it did and thanked all those that attended.

Eighteen applications were received for membership to be acted upon at the next meeting; they were turned over to the Board of Managers.

Mr. George Brown resigned as librarian, not being able to give time to the job. Mr. Arthur J. Mintie was elected to that office.

A motion was made a committee of three be appointed to act as a member-

ship committee to bring in new members and to get in touch with the owners of plating plants to remind their platers of what this society is doing for the platers. Mr. Hardy, Mr. Charles F. Campbell, and Mr. Edward T. Ehrhardt were appointed.

Boston Branch has been meeting every three months or so in the past, so a motion was made that the Branch meet every month hereafter on the first Thursday.

Motion was made that the regular order of business shall proceed without interference after which the chair will be turned over to the librarian who will conduct the question box. Every member is asked to place a question in the box each meeting. Mr. Mintie asks the co-operation of every member to help him and he says that he will have a speaker for most every meeting to bring the members to the meeting.

Our librarian will have as the speaker April 2nd, Mr. Victor Buckley of the Evans Case Co. His subject will be "Bright Nickel." Mr. Mintie gave a very interesting talk on the educational session of Bridgeport Branch held March 14th, and it was very interesting A short discussion took place after which the Branch adjourned at 11 P.M.

Boston branch met Thursday the 2nd at the Hotel Manger at 8 P. M. with Pres. Wood in the chair.

Reading of the minutes, bills and communications read and placed on file.

Eighteen new members were elected at this meeting and seven applications read for the first time and turned over to the board of managers.

A motion was made that the next meeting of the branch be held at the Squantum Yacht Club, Quincy, Mass. Supper will be served — all the members were asked to attend — a good time for all.

Motion was made that the branch hold a picnic sometime in June. The following were appointed as a committee to make arrangements: Harry J. Lack, Arthur J. Mintie, and Bert Sage.

A suggestion was made that the branch should try and get the 1937 convention for Boston, with the result that a recommendation was made that the branch appropriate the sum of twenty-five dollars, with the approval of the board of managers, to be used for buttons or literature to bring to the convention this year.

The librarian took over the chair as we had a speaker, Mr. Elton V. Buckley of the Evans Case Co. The subject of his talk was "Bright Nickel." He gave a very interesting talk, showing samples of nickel done in the bright nickel solutions which were very good. He answered all questions for the mem-

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bers. A rising vote of thanks was given Mr. Buckley for his interesting talk.

Our librarian then held the question box. He found four questions as follows: No. 1. — What is a good insulator to prevent treeing on plating barrel? Ans.—Use bakelite to cover exposed parts. No. 2. — How should the Tri-valent Chrome stand in a Chrome sol. Ans. — Not over .4 another 1.1. No. 3. — How is Russian gold done? This is a question that the branch would like to have answered by some other branch.

No. 4. — Here is another question for other branches and we would like to hear from them. We are having trouble cleaning small brass parts for tumble nickel. The oil is called "thread oil" 4% Chlorinated Sulphur in mineral oil. What will clean these parts cheaply?

Meeting adjourned at 11 P. M.

A. W. GARRETT, *Sec.*

The Boston Branch held its Second Annual Banquet and Technical Session on February 29th at the Hotel Lenox in Boston. Mr. Oliver Sizelove presented a fine paper on Zinc Solutions, and Dr. Wm. Blum followed with a generous talk on the recent work at the Bureau. The Branch owes much to these speakers for their papers and the spirited discussion following them.

Following supper the meeting was turned over to the development of the Branch membership. Pep talks by "Cyanide Bill" Schneider and "Zapon" John Oberender started the ball rolling and the signatures began to appear when "Greaseless Bob" Leather and "Agate Bill" Chase offered to pay the first year's dues for the first men to sign up. Ten applications were received and others are expected to follow.

Boston Branch is going places—plan to come and see in 1937.

DON WOOD, *Pres.*

LOS ANGELES BRANCH

Minutes of the Los Angeles Branch A. E. S. regular monthly meeting held Feb. 12th, 1936, at the Rosslyn Hotel.

In the absence of both the president and vice-president, M. D. Rynkofs acted as chairman of the meeting.

Mr. Horner representing the Santa Fe Railway Co., spoke to us for a few minutes asking us as a body to support his company in their application to the railroad commission for a permit to operate a bus line in California.

Minutes and financial report of the previous meeting were read and accepted.

Bills amounting to $9.55 were read and ordered paid.

The secretary read the application of Joe Charles Bessolo who applied for admission as an active member. The application was turned over to the Board of Managers.

Raymond Solivan and H. A. Mills were elected as active members. Initiation was postponed until next meeting because of the absence of the president and vice-president.

The Branch voted to go on record as favoring the application of the Santa Fe Railroad for a permit to operate a bus system in California. Mr. Rynkofs was elected to draw up the resolution and forward it to the Railroad Commission.

The members were reminded of the card party the Branch is holding Feb. 22nd, and each member was urged to bring as many friends as possible.

Ray Vasquez acted as librarian in the absence of Ray Bray. He found the following questions in the box:

Q. What is the brown accumulation in the bottom of a cyanide dip?

A. Most likely just a harmless collection of impurities from the cyanide and the work that has been dipped in it.

Q. What is the best method of testing the hardness of a chrome plate?

A. No one seemed to be sure of the best method.

Q. Has any one a formula for tungsten plating?

A. Nobody had one. It was suggested the writer of this question and the previous one write to Dr. Blum at the Bureau of Standards.

Q. What is the best method to remove Parkerizing from steel?

A. A dip in muriatic acid was the only method the members knew. It was suggested that a chromic acid solution might remove Parkerizing.

Q. How much barium carbonate is required to neutralize one ounce of Sulphuric acid?

A. Two ounces.

Q. Is a lead lined tank practical for a cadmium solution?

A. No. The cyanide attacks the lead. EARL COFFIN, *Sec.*

NEWARK BRANCH

The regular meeting of the Newark Branch A.E.S. was held on Friday evening February 7, 1936 at the North End Club, Newark, N. J. The meeting was called to order at 9 P. M. and the following officers reported present: Pres. Sam Taylor; Treas. Nelson Seivering; Trustee, George Wagner. Due to the absence of our Secretary the minutes of the previous meeting were read by George Wagner who acted as secretary for that meeting.

Chairman Horace Smith of the Banquet Committee reported progress and the tickets will be in the mail before the end of the month.

Mr. Oliver Sizelove gave a report on his visit to the Binghamton Elmira Branch and stated that they had between forty and fifty persons present.

Our Secretary Mr. George Reuter tendered his resignation as secretary of the branch. Due to business he felt he was unable to carry on the work. His resignation was accepted and Mr. Geo. Wagner was elected secretary for the balance of the year.

There was a discussion of a new meeting place and Mr. Horace Smith agreed to give a report at the next meeting.

Due to the absence of our librarian Mr. Lou Taylor introduced the speaker for the evening. Mr. Meerbott our speaker gave a fine and interesting talk on soaps. He explained how soaps are made and how they clean and at the end of the talk there was quite a discussion on the use of soaps in the plating room. Lou Taylor asked if anyone heard of producing brass by immersion dip. Mr. Meerbott was given a vote of thanks and the meeting adjourned at 10:30.

The regular meeting of the Newark Branch A.E.S. was held on Friday evening March 6, 1936 at the Hotel Douglas, Hill Street, Newark Branch's new meeting quarters.

The meeting was called to order at 8 P. M. with president Sam Taylor presiding, all officers present. The minutes of the previous meeting were read and approved. An application of Conrad Corda (active) was received and voted to take the regular course.

The following transfers were granted: Austin Fletcher (active) transferred to Binghamton-Elmira branch. Robert J. Hilgengerg (active) transferred to Binghamton-Elmira branch.

Mr. Horace Smith chairman of the banquet committee, reported that all plans for our Annual Banquet on April 18, 1936 were nearly completed and

that a good time would be on hand for all who would attend.

Mr. Oliver J. Sizelove, our speaker for the evening, gave a very interesting talk on zinc deposits and exhibited samples plated in four different types of zinc plating baths, all of which proved very satisfactory in appearance. There was quite a discussion on zinc and cadmium plating and Mr. Sizelove in answering some of the questions stated that zinc and cadmium of even thickness would serve as protective coatings with about equal corrosive resistance or with approximately equal corrosive resistance.

Mr. Sizelove was given a vote of thanks for his talk and the meeting adjourned at 10 P. M. Thirty-seven members were present.

GEORGE WAGNER, *Sec.*

MILWAUKEE BRANCH

Milwaukee Branch A.E.S. held their regular meeting March 13, 1936. All officers present. Two applications were received for membership: Mr. Wm. DeCheck, 3431 - 8th Ave., Kenosha, Wis. and Mr. Rodney Olsen, RR2, Box 215, Racine, Wis. Two applicants, Mr. Vincent Sheehan and Mr. Bernard Weslowski were elected associate members.

Milwaukee Branch has decided to have a picnic again this year.

The Smoker Committee report everything taken care of.

The speaker of the evening was Mr. Phil Ritzenthaler, who talked on "The Engineer and Plater," which was followed with lunch and refreshments, served by the Board of Managers.

The Milwaukee Branch held their annual smoker, Saturday, March 21, at 7.30 P. M. — the largest gathering Milwaukee has ever had the pleasure of entertaining. With well over 200 present, registrations covered a large territory from as far south as St. Louis as far east as Detroit, as far west as Omaha and as far north as Minneapolis.

Our President, Mr. Robert Steuernagel opened the session introducing Mr. Pat Sheehan as "Master of Ceremonies."

We were rather privileged in having Mr. Oliver Sizelove, Mr. C. Clendinin and Mr. Geo. Hogaboom as speakers.

Smoker Chairman, Mr. Dan Wittig and his committees did a fine job. Congratulations are in order.

. A delicious buffet lunch was served with refreshments that Milwaukee is not unknown for; followed by a floor show that had the approval of all who witnessed it.

Our genial neighbors to the south, Chicago Branch, made a very good showing — the group included Mr. Gilbertson, Past Supreme President; Mr. Frank Hanlon, Mr. Oscar Servis, Mr. C. Berry, Mr. H. Smallman, Mr. Jim Hanlon, Mr. Stenberg and many others. R. C. BINDER, *Sec.-Treas.*

ST. LOUIS BRANCH

Regular meeting of St. Louis Branch A.E.S. was held on Friday, March 6, 1936, at Central Y.M.C.A. Dinner was served at 6:15 P. M., after which a meeting was held. Three visitors.

Discussions were held on Bright Nickel and Bright Zinc, and Acid spots on Chrome plated parts, and how to remove them without buffing.

Owing to a dinner dance given by Washington University, Dr. Stout could not attend meeting.

A motion was made and seconded that St. Louis Branch give a vote of thanks to the LaSalco Inc., for all the nice prizes they donated for our banquets. Motion was then made that we hold our next meeting at the Central Y.M.C.A., April 3, 1936, at which time we hope to have Dr. Stout with us.

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At this meeting anyone interested in becoming a member may attend.

Meeting adjourned at 10:00 P. M.

C. T. McGINLEY, *Sec.*

WATERBURY BRANCH

Regular meeting of Waterbury Branch A. E. S. was held Friday evening March 13th, in Engineers Hall. President Tennant Elwin presided and a large gathering was present. Communication was received from the Bridgeport Branch announcing their educational session and banquet at the Stratfield Hotel. At the conclusion of routine business, President Elwin introduced Mr. George Hopkins, vice-president of MacDermid, Inc., who gave a very interesting talk in "Recent Advances in Metal Cleaning". The speaker gave an insight of the objects being sought by most cleaning manufacturers of today. "Building up to a standard rather than down to a price," seems to be the slogan. At the conclusion of the address some very important cleaning problems were discussed; from remarks brought out, it could be readily seen that the subject of "Cleaning" was an old one, yet from time to time, problems in this line are presented, some of which are mastered and others are not. A note of thanks was extended Mr. Hopkins, for an evening well spent.

W. F. GUILFOILE, *Sec.*

ANDERSON BRANCH

Anderson Branch held their March 9th meeting at the Y. M. C. A. Dinner was served to forty members and guests.

The Branch was very fortunate in having as their evening's speaker, Mr. George B. Hogaboom, nationally known authority on plating. Mr. Hogaboom spoke on "Protective coatings for Metals", and illustrated his lecture with slides, making it very interesting and instructive.

After some time given to questions and discussions, meeting adjourned at 9:45 P. M.

Anderson Branch held their March 23rd meeting at the Y. M. C. A. 7:30 P. M. Many of our members missed by their failure to attend, one of the most interesting discussions on chromium plating, given by Mr. Castell, that our Branch has had the opportunity to hear. Most all of the attendance was from the ranks of our newer members, but in the opinion of the secretary, the evening could also have been profitably and pleasantly spent by our older members, attending this meeting.

The evening's lesson embraced many phases of chromium plating on nickel over brass and steel; also, the plating of gauges, dies and molds.

During the period given to questions and discussion, the subject of Bright Nickel was again brought up. Most comments on this phase of plating were rather heated and ended in a general agreement that much was to be learned before platers using this type bath could sit back and enjoy life again.

Meeting adjourned after secretary's report at 9:30 P. M.

J. W. MINTON, *Sec.*

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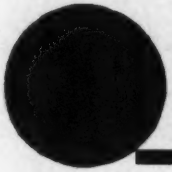

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Please mention THE MONTHLY REVIEW *when writing*

Membership Report

To March 18, 1936

ELECTED

	Branch
Joseph Frank Moore, 2148 Sanger St., Phila. Pa.	Philadelphia
Daniel Miller Specht, 357 Park Ave., Milton, Pa.	Philadelphia
Edward W. Lafferty, 20 So. 38th St., Phila. Pa.	Philadelphia
Jos. H. Moneweck, 660 Hazelwood Ave., Detroit, Mich.	Detroit
Eric G. Sampson, Jr., Yale & Towne Mfg. Co., Detroit, Mich.	Detroit
Roy A. Johnson, Belke Mfg. Co., 1627 West Fort, Detroit, Mich.	Detroit
F. H. Bruening, 1372 Monroe Ave., Apt. 21, Rochester, N. Y.	Rochester
Henry Norgren, 112 Alden St., Syracuse, N. Y.	Rochester
Ray J. Berghold, 643 Post Ave., Rochester, N. Y.	Rochester
Michael Rubin, 1095 Trunbull Ave., Warren, Ohio	Cleveland
H. A. Mills, 266a Settle St., San Pedro, Cal.	Los Angeles
Raymond Solivan, 10128 Culver Blvd., Culver City, California,	Los Angeles
M. Vincent Sheehan, 1319 N. 23rd St., Milwaukee, Wis.	Milwaukee
Bernard Wesolowski, 2478 So. 15th St., Milwaukee, Wis.	Milwaukee
J. Grimley, 44 Shirley St., Toronto, Ont.	Toronto
F. Whalen, 6333 S. Paulina St., Chicago, Illinois,	Chicago
W. Radunz, 4725 Castello Ave., Chicago, Illinois,	Chicago

APPLICATIONS

Wm. DeCheck, 3431 8th Ave., Kenosha, Wis.	Milwaukee
Frank Toriden, 6717 Bonna Ave., Cleveland, Ohio	Cleveland
Rodney Olsen, R. R. 2 Box 215, Racine, Wis.	Milwaukee
C. R. Roberts, 112 Margaret St., Kitchener, Ont.	Toronto
M. Brodie, c/o Ontario Steel Products, Chatham, Ont.	Toronto
E. C. Hillier, c/o Muellers Ltd., Sarnia, Ont.	Toronto
S. J. Borta, 2324 W. Walton St., Chicago, Ill.	Chicago
Cedric Arthur Vincent-Davies, E. I. du Pont de Nemours & Co. Inc., R. H. Chem. Dept., Wilmington, Del.	Balto-Washington
Gilman Parater, 1205 C St., N. E., Washington, D. C.	Balto-Washington
Harris M. Lyon, 2250 Minn. Ave., S. E. Washington, D. C.	Balto-Washington
Samuel R. Warnock, 258 Kentucky Ave., S. E. Washington, D.C.	Balto-Washington
Emory L. Plate, 4601 Leeds Ave., Balti. Md.	Balto-Washington
Roland S. Gregg, 5600 Wexford Road, Balti. Md.	Balto-Washington
Mathew J. Kraft, 511 Clay St., Balti. Md.	Balto-Washington
Paul J. Dean, 20 T. St., N. E., Washington, D.C.	Balto-Washington
Christ Lombardo, 56 Fifth St., Rochester, N. Y.,	Rochester

RE-INSTATED

D. Woodhouse, c/o Callander Foundry Co., Guelph, Ontario